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SELECTED WATER RESOURCES ABSTRACTS

VOLUME 17, NUMBER 10
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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
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The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Office of Management ond Budget through September 30, 1985.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey, MS 421
Reston, VA 22092

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Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

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04 WATER QUANTITY MANAGEMENT AND CONTROL

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05 WATER QUALITY MANAGEMENT AND PROTECTION

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06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

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SELECTED WATER RESOURCES ABSTRACTS

2. WATER CYCLE

2A. General

SUPPLY COEFFICIENT OF INTERIOR LAKES IN XIZANG,
Academia Sinica, Nanjing (China). Inst. of Geography.
F. Yunqi.
Oceanologia et Limnologia Sinica, Vol. 14, No. 2, p 127-137, March, 1983. 5 Fig, 11 Ref.

Descriptors: *Supply coefficient, *Lakes, *Xizang, China, Evapotranspiration, Catchment areas, Mathematical models, Water exchange, Chemical properties, Climates, Water quality, Physical properties.

The interior lakes in Xizang cover an area of about 30% the total lake area throughout the country, should these lakes within a specific period remain in a state of relatively stabilized water equilibrium, the equation of water equilibrium of interior lakes will be F1/F2=(z/x-1)/k. F1 stands for catchment area; F2 for lake area; z for evaporation on the lake surface; x for precipitation in the valley; k for runoff coefficient on the land surface of the valley and F1/F2 is called the supply coefficient of interior lakes. The supply coefficient of interior lakes relies first on climatic factors and, then, on ground conditions. The more the evaporation over the precipitation or the more unfavorable the land surface of the valley to the formation of runoff, the greater the supply coefficient of lakes, or, otherwise, the smaller it is. According to the analysis of tens of interior lakes typical in Xizang, the characteristics of such supply coefficient are the differential supply coefficient of interior lakes in different climatic regions is subject to the control of climatic factors, the different supply coefficient of interior lakes in the same region is conspicuously affected by ground conditions, and the different supply coefficient for those connected interior lakes is determined primarily by the exchange rates of various lake-water bodies. The mentioned supply coefficient of interior lakes in Xizang is fundamentally in conformity with the changing trend of chemical characteristics of lake water, in other words the greater the supply coefficient, the higher the degree of mineralization or, otherwise, the smaller it is. This is because when the climate gets more arid, the smaller lake area will be capable of keeping its water equilibrium under the similar catchment area and ground conditions and, accordingly, soluble saline matter will enter into the lake to an increasing extent. Since the on-the-spot data are not available for most of the interior lakes in Xizang, the supply coefficient value of the lake measured by means of highly accurate topographic maps will not only provide an outline of physical geography in the lake region from one aspect, but also forecast and evaluate the water quality of some lakes. (Murphy-IVI)
W84-03515

WATER RESOURCES OF THE TRUK ISLANDS,
Geological Survey, Honolulu, HI. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-03565

WATER RESOURCES OF THE YAP ISLANDS,
Geological Survey, Honolulu, HI. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-03568

GUIDE TO GEOLOGIC AND HYDROLOGIC IDENTIFICATION OF FRESHWATER WETLANDS ON THE TUG HILL PLATEAU, NEW YORK,
Syracuse Univ., NY. Dept. of Geology.
R. J. Jordan.
Report, Temporary Commission on Tug Hill, June, 1978. 25 p, 11 Fig, 3 Tab, 5 Ref.

Descriptors: *Wetlands, *Hydrologic systems, *Geologic formations, Moraines, Basins, Bedrock, Snowmelt, Vegetation, Soil moisture retention, Wet climates, Areal precipitation, Drainage patterns.

Freshwater wetlands in New York have been cataloged and classified in the New York State Wetland Inventory (NYSWI). Wetland vegetative classes and physical attributes are produced by the interaction of climate and geologic environment. Wetlands have been adequately described but not explained in the NYSWI. This guide outlines geologic based classifications explaining wetland occurrence and interprets local hydrologic systems indicated by different geologic wetland classes. The guide is based on the author's doctoral research. The classification was predicated on the premises that the vegetative and physical attributes of wetlands recorded in the NYSWI were a reflection of the local hydrologic setting. The Tug Hill Plateau receives over 45 inches of water equivalent precipitation annually, which is retained in certain geologic settings leading to wetland formation. The Plateau is characterized by six basic types of geologic wetlands: intramorainal basins, wetlands related to bedrock, wetland basins in meltwater channels, and large wetland basins. The types can be distinguished by size, vegetation, stream contact, and drainage characteristics. The author suggests that the generalized material and landform descriptions for specific Tug Hill locations be analyzed along with the geologic setting description. (Fazio-Omniplan)
W84-03655

HYDROLOGY REPORT FOR THE SALMON RIVERS COOPERATIVE PLANNING BOARD AREA,
New York State Temporary Commission on Tug Hill, Watertown.
L. W. Garner, J. Soule, J. Mason, E. Morrow, and T. Germain.
Report, Salmon Rivers Cooperative Planning Board, September, 1976. 34 p, 3 Fig, 12 Tab, 3 Ref, 5 Maps, 1 Append.

Descriptors: *Areal hydrogeology, *Surface water, *Surface-groundwater relations, *Stream classification, *Regional planning, Groundwater movement, Groundwater availability, Drainage patterns, Wetlands, Ponds, Swamps, Streams, Regional floods, Management planning.

Water is a generally plentiful resource in the Salmon River Cooperative Planning Board area of New York. What is important in a local planning effort is what man does with and to water while it is in the environment. A complex system of surface deposits makes the groundwater of the Tug Hill Region difficult to trace. The surface water drainage pattern is equally ill-defined. Much of the surface water is of good quality. The report describes the hydrology in each of the three town regions of Parish/Parish, Orwell, and Albion/Altmar and in the Salmon River Cooperative Planning Board area in general. Groundwater is generally available throughout the area in quantities sufficient for only domestic and farm supplies. Except for a small portion of Orwell and Albion townships, the groundwater yield without replacement is less than 10 gallons per minute for six inch or greater diameter wells. The surface water drainage pattern is exclusively incorporated within the Lake Ontario Basin, in which the streams flow primarily from east to west. About 9.4% of the total land areas in both Albion/Altmar and Parish towns are wetlands of 12.4 acres of more. Less than 5% of Orwell's land area falls in this category. The importance of a regional approach to planning is exemplified by the ground and surface water systems. What happens to the water systems of one area has a direct effect upon the water systems of a neighboring area. (Fazio-Omniplan)
W84-03657

EVALUATION OF THE UNCERTAINTY IN PREDICTING HYDROLOGIC INPUTS AND THE EFFECT OF UNCERTAINTY ON WATERSHED MANAGEMENT DECISIONS RELATED TO WATER OR SOIL CONSERVATION MEASURES FOR SMALL WATERSHEDS,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
T. Maddock, III.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84-154384, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Research Center Completion Report, February, 1984. 3 p. Project No. OWRT A-112-ARIZ (1), Contract/Grant No. 14-34-0001-2103.

Descriptors: *Watershed management, Transmission losses, Flood control, Water demand, Water yield, Bayesian risk, *Arizona, Soil conservation, Water conservation, *Risks.

The effects of uncertainty in estimating input parameters to the SCS method on management decisions related to water demand and flood control are examined. Included in the SCS method was a means for estimating transmission losses from emphemeral streams. Parameters studied include the precipitation depth, curve number, and transmission loss parameters. The latter involve a stream channel network statistic and stream channel segments of varying lengths and widths and effective hydraulic conductivities for channel bed and out of bank flow. Input parameters were characterized by probability distributions based on field survey. Several watersheds in Arizona were used as site conditions. Peak and volume discharge and their associated uncertainties were used in conjunction with standard design procedures for structures to address the problem of flood control or water demand. Bayesian risk analyses was used to assess the effect of uncertainty on the above objectives. In addition, it was used in conjunction with the more sensitive model parameters to facilitate decisions regarding which parameters require greater study to improve predictability, reduce uncertainty and at what economic cost. Due to curtailment of proposed funding levels, it was not possible to complete all analyses. The Agricultural Research Service, through a cooperative agreement with the University of Arizona and the Southwest Rangeland Watershed Research Center in Tucson, Arizona, has continued support of this project. The expected complete date is mid 1984.
W84-03668

RAINFALL-RUNOFF RELATIONS AND EXPECTED STREAMFLOW IN WESTERN KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
P. R. Jordan.
Kansas Water Office, (Topeka), Bulletin No. 25, 1982. 42 p, 25 Fig, 15 Ref.

Descriptors: *Annual runoff, Rainfall-runoff relationships, Runoff volume, *Streamflow, Streamflow depletion, *Kansas.

Simple rainfall-runoff relations showed decreases of 50 percent or more, since the mid-1960's, in the runoff resulting from a normal amount of precipitation for the South Fork Solomon River above Webster Reservoir, Beaver Creek, and the upper Smoky Hill River. Less significant decreases were found for the North Fork Solomon River basin upstream from Kirwin Reservoir and for the Pawnee River. A detailed moisture-accounting model for the South Fork Solomon River and Beaver Creek showed runoff for 1967-75 to be less than 50 percent of the amount resulting in earlier years from the same amount of precipitation. A decrease in base flow, which occurred concurrently with an increase in ground-water pumpage, accounts for about one-fourth to one-third of the decrease in runoff. The remainder of the decrease probably is due to farming practices that increase the evapotranspiration from soil moisture and water surfaces. The moisture-accounting model also was used to estimate the runoff that might occur in the future if the farming practices continue as they were during 1967-75. For those conditions, the runoff may average 33,000 acre-feet per year in South Fork Solomon. (USGS)
W84-03671

Field 2—WATER CYCLE

Group 2A—General

HYDROLOGY.
New York State Temporary Commission on Tug Hill, Watertown.
Report, Jefferson County Snowbelt Cooperative Planning Board, April, 1978. 29 p, 4 Fig, 5 Maps, 3 Append.

Descriptors: *Hydrology, *Management planning, *Water management, *Land use, *Local precipitation, Areal precipitation, Groundwater availability, Water quality, Surface runoff, Wetlands, Swamps, Annual floods, Stream classification, Catchment areas, Snowpack, Water quality standards, Administrative regulations.

The Snowbelt Cooperative Planning Board area consisting of the towns of Adams, Lorraine, and Rodman has abundant water resources, but a quality water supply is a limited resource, making the use and management of water resources a concern. This report describes the important hydrologic and water management considerations as they relate to land use planning in the Tug Hill region, and inventories water resources of the Snowbelt Cooperative Planning Board. Precipitation is distributed over the year with an average low of 2.31 inches in April to 4.32 inches in November. The snow pack varies between 7-10 inches of water content, which peaks about March 15. Surplus water available for yearly runoff may vary between 16-20 inches within the towns and over 25 inches for the individual drainage basins and their total areas. The cooperative planning area includes parts of five different drainage basins. Within each town are regulated wetlands. Each town has designated flood hazard areas, but a majority follow close to the stream banks. No large open bodies of water are in the three towns. The gorges in Lorraine and Rodman are special water resource areas. Special considerations and management may follow with a salmonid fisheries program in the identified class 1 streams. Several streams could quality for unique stream status. Groundwater is available through springs or shallow aquifers, but could be a problem requiring deep, possibly 'hard water,' wells in the limestone bedrock. (Fazio-Omniplan)
W84-03700

LOW-TEMPERATURE EFFECTS ON FLOW IN SAND-BED STREAMS,
Tianjin Univ. (China).
R.-J. Hong, M. F. Karim, and J. F. Kennedy.
Journal of Hydraulic Engineering (ASCE), Vol. 110, No. 2, p 109-125, February, 1984. 7 Fig, 1 Tab, 14 Ref. NSF grant CEE-8109252.

Descriptors: *Temperature effects, *Flow, *Streams, Sand beds, Alluvium, Alluvial streams, Sediment transport, Model studies, Sediment concentration, Bed load, Mathematical models, Flow velocity, Flow friction.

Laboratory experiments were performed in a 40-ft wide, 1-ft deep (12-m x 0.6-m x 0.3-m) tilting flume to elucidate the effects of temperature variations on the flow and sediment-transport characteristics of streams with beds of fine sand (D50 = 0.11 mm in these experiments). Nearly constant depth was maintained with three different constant discharges, and temperatures were varied from approximately 30 C to 0 C. In the two series of experiments at higher velocities and Froude numbers, temperature reductions produced major increases in sediment discharge and uniformity of concentration distributions and smaller, but still significant, increases in friction factor and bedform height. An analysis of the experimental results within the framework of a theoretical sediment-transport model revealed that the increased sediment discharge with decreasing water temperature in flows carrying significant amounts of suspended sediment are caused by increases in both bed-layer sediment concentration and the uniformity of the concentration profiles. The sediment discharges of low-velocity (F = approximately 0.30) flows, which were just above the threshold of sediment motion, were not significantly affected by water temperature. It was concluded that temperature affects the near-bed concentration only if the bed-layer Reynolds number (based on bed-layer thickness) is greater than about 20. (Author's abstract)
W84-03717

COMPARISON BETWEEN THE PROBABILITY AND SIMULATION PROCEDURES FOR STORAGE ANALYSIS,
Monash Univ., Clayton (Australia).
For primary bibliographic entry see Field 6D.
W84-03775

ANALYSIS OF THE INFLUENCE OF THE GEOMORPHOLOGICAL CHARACTERISTICS OF A RIVER BASIN ON THE PARAMETERS OF A GLOBAL HYDROLOGICAL MODEL AND ON THE DISCHARGE AT THE OUTLET (ANALYSE DE L'INFLUENCE DE LA PHYSIOGRAPHIE D'UN BASSIN VERSANT SUR LES PARAMETRES D'UN MODELE HYDROLOGIQUE GLOBAL ET SUR LES DEBITS CARACTERISTIQUES A L'EXUTOIRE),
Bureau de Recherches Geologiques et Minieres, Orleans (France).
B. Mazenc, M. Sanchez, and D. Thiery.
Journal of Hydrology, Vol. 69, No. 1-4, p 97-118, February, 1984. 8 Fig, 16 Tab, 4 Ref.

Descriptors: *River basins, *Model studies, Hydrologic models, Brittany, France, Mathematical equations, Climatic data, Geomorphology.

The influence of the geomorphological characteristics of a river basin on the parameters of a hydrological model of the basin and on some characteristics of the discharge was investigated. A statistical analysis has been applied to a set of 17 river basins from Brittany, France. Equations have been derived which make it possible to determine the parameters of a global model for any new river basin in this area of Brittany. When a calibration of the model is not possible, for example at an ungauged site, it is possible to compute discharge with a reasonable accuracy by this method. The analysis of the relations between geomorphological characteristics and discharge lead to equations which make it possible to compute design discharges provided that climatological data are available. (Baker-IVI)
W84-03778

STOCHASTIC MODELS IN AGRICULTURAL WATERSHEDS,
Utah State Univ., Logan. Dept. of Civil and Environmental Engineering.
C. J. Duffy, L. W. Gelhar, and P. J. Wierenga.
Journal of Hydrology, Vol. 69, No. 1-4, p 145-162, February, 1984. 7 Fig, 1 Tab, 20 Ref.

Descriptors: *Stochastic models, *Agricultural watersheds, Drainage systems, Deep percolation, Soil moisture, Irrigation models, Drainage models, Recharge, Rio Grande Valley, New Mexico.

Recent developments in stochastic time-series methods in water resources have demonstrated that a stochastic approach is often useful for characterizing complex natural processes. A stochastic time-series approach using spectral analysis theory is developed and applied to drainage analysis of an agricultural watershed, Rio Grande Valley, New Mexico, U.S.A. The spectral theory demonstrates that a linear reservoir model is a suitable approximation to the Dupuit aquifer over a wide range of frequencies. A first-order perturbation of the variables allows the system parameters to be evaluated from both the stochastic solution of the fluctuating or zero-mean process, and the temporal-mean or steady-state solution. Deep percolation is estimated by first assuming a 'no storage' situation in which recharge is a constant fraction (leaching fraction) of applied water. A second approach to deep percolation incorporates a soil-moisture reservoir to simulate storage in the soil zone. The equations developed are useful for characterizing drainage systems which exhibit a statistically stationary response to rainfall and/or irrigation. (Murphy-IVI)
W84-03780

CHANNEL NETWORKS: A GEOMORPHOLOGICAL PERSPECTIVE,
State Univ. of New York at Buffalo. Dept. of Geography.
A. D. Abrahams.
Water Resources Research, Vol. 20, No. 2, p 161-168, February, 1984. 25 Fig, 2 Tab, 151 Ref.

Descriptors: *Geomorphology, *Channels, Catchment areas, Model studies, Simulation analysis, Stochastic models.

The study of channel networks has been dominated since 1966 by the random model. However, recent work has shown (1) that although the topological properties of small networks conform to the random model more closely than those of large ones, even small networks exhibit systematic deviations from topological randomness and (2) that the topological and length properties of channel networks are controlled to a large degree by the spatial requirements of subbasins and the need for these subbasins to fit together in space, by the size, sinuosity, and migration rate of valley bends, and by the length and steepness of valley sides. The factors that control the density properties of channel networks vary with the scale of the investigation and the geomorphic processes governing channel initiation. Although progress has been made toward a satisfactory stream junction angle model, further work is needed. The evolution of channel networks has been investigated by a variety of methods, including the development of conceptual and simulation models, the monitoring of small-scale badland and experimental drainage basins, and the substitution of space for time. The morphology of most channel networks in largely inherited from the past or strongly influenced by inherited forms. Inasmuch as there is no way of ever knowing the origin or complex history of such networks, the use of stochastic models in their study seems unavoidable. (Author's abstract)
W84-03815

OPTIMAL DETERMINATION OF LOSS RATE FUNCTIONS AND UNIT HYDROGRAPHS,
Texas Univ. at Austin. Dept. of Civil Engineering.
O. Unver, and L. W. Mays.
Water Resources Research, Vol. 20, No. 2, p 203-214, February, 1984. 4 Fig, 3 Tab, 22 Ref.

Descriptors: *Optimization, *Water loss, *Unit hydrographs, Model studies, Mathematical studies, Rainfall-runoff relationships, Nonlinear programming, Shoal Creek, Austin, Texas, Wills Creek, Cumberland, Maryland, Watersheds.

An optimization model can be used in the determination of loss rate functions and unit hydrographs using observed rainfall and runoff data. Composite unit hydrographs and loss rate parameters can be determined by using several multiperiod storms simultaneously or using individual multiperiod storms. The model is a nonlinear programming problem so that a generalized reduced gradient method is used as the solution technique. Kostiakov's, Philip's, Horton's, and the phi index methods are used to illustrate the model for comparative purposes. An infiltration equation that includes rainfall intensity is also introduced and is compared with the others by using the optimization model. The model is applied to storms for a hypothetical example, Shoal Creek watershed in Austin, Texas, and Wills Creek watershed near Cumberland, Maryland. (Murphy-IVI)
W84-03818

ACID MINE DRAINAGE FROM RECLAIMED COAL STRIP MINES 1. MODEL DESCRIPTION,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
D. B. Jaynes, A. S. Rogowski, and H. B. Pionke.
Water Resources Research, Vol. 20, No. 2, p 233-242, February, 1984. 3 Fig, 2 Tab, 51 Ref.

Descriptors: *Acid mine drainage, *Strip mines, Model studies, Mathematical studies, Pyrite, Oxidation, Oxygen balance, Wastewater analysis, Prediction.

The development and evaluation of best reclamation and management techniques is difficult because of the expense and time required to implement and assess the value of a specific practice and because of the great variability between even adjacent strip mine sites. The development of a mathematical model that describes acid production and

leaching from strip-mined lands would facilitate the development of sound management practices by allowing assessment of each technique for any given condition to be made in minutes rather than years. A model describing the long-term oxidation of pyrite and the removal of reaction products from reclaimed coal strip mines using both direct-oxygen and ferric iron oxidation of pyrite is considered. The pyrite oxidation rate is assumed to be controlled by first-order, solid-liquid kinetics and the rate of simple diffusion of oxidant into reactive, coarse, stone fragments. The oxygen supply into the reclaimed profile is considered to be governed by one-dimensional gas diffusion. Ferric iron is produced by both purely chemical and bacterial oxidation of ferrous iron. Activity of the iron-oxidizing bacteria is controlled by the energy available from ferrous oxidation, as measured by the ferric/ferrous ratio, and from a combination of potentially inhibiting factors: the oxygen concentration in the spoil air, the hydrogen ion concentration in solution, and the soil temperature. Bacterial activity and pyrite oxidation are linked through a shared environment. The side reactions considered include the complexation and precipitation of ferric iron and the interaction between hydrogen ion in solution and the spoil matrix. Soluble reaction products are removed from the reclaimed profile by percolating water. (Murphy-IVI)
W84-03820

ACID MINE DRAINAGE FROM RECLAIMED COAL STRIP MINES 2. SIMULATION RESULTS OF MODEL,

Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
D. B. Jaynes, H. B. Pionke, and A. S. Rogowski.
Water Resources Research, Vol. 20, No. 2, p 243-250, February, 1984. 11 Fig, 3 Tab, 6 Ref.

Descriptors: *Acid mine drainage, *Strip mines, *Simulation analysis, Model studies, Mathematical studies, Pyrite, Oxidation, Oxygen balance, Hydrogen ion concentration.

Acid mine drainage from reclaimed coal strip mines is simulated by use of a comprehensive model. The simulated concentrations of key components are well within the ranges of measured values from reclaimed mines. In systems without iron-oxidizing bacteria the simulations indicate that oxygen is the only important oxidizer of pyrite. The oxidation of ferrous to ferric iron by purely chemical means is too slow to affect the overall oxidation rate of pyrite and is not important in these systems. For the typical physical parameters used here the diffusion rate of oxygen is the primary factor controlling the rate of pyrite oxidation. The pyrite oxidation rate is decreased by decreased air-filled porosity, by increased tortuosity of the oxygen diffusion path, by increased size of the spoil fragments, and by burying the pyritic material at deeper depths. Where oxygen resupply is not limiting the results indicate that iron-oxidizing bacteria can greatly increase the rate of pyrite oxidation. Whether or not bacteria are important in these zones depends primarily on the pH of the spoil solution. In the optimal pH range, between reduced bacterial efficiency and reduced ferric iron solubility ($2.0 < \text{or} = \text{pH} < \text{or} = 3.0$), the pyrite oxidation rate is accelerated by bacterially produced ferric iron. The extent and type of chemical reactions between H(+), produced by pyrite oxidation, and the spoil matrix appears to be crucial in establishing the pH of the spoil solution. (Murphy-IVI)
W84-03821

PROBLEM OF PERMISSIBLE COVARIANCE AND VARIOGRAM MODELS,

Ecole Nationale Superieure des Mines de Paris (France). Centre de Geostatistique et de Morphologie Mathematique.
G. Christakos.
Water Resources Research, Vol. 20, No. 2, p 251-265, February, 1984. 5 Fig, 33 Ref.

Descriptors: *Permissible Covariance, *Variogram models, Mathematical models, Hydrologic models, Geostatistics, Polygonal models.

The covariance and variogram models (ordinary or generalized) are important statistical tools used in various estimation and simulation techniques which have been recently applied to diverse hydrologic problems. For example, the efficacy of kriging, a method for interpolating, filtering, or averaging spatial phenomena, depends, to a large extent, on the covariance or variogram model chosen. The aim of this article is to provide the users of these techniques with convenient criteria that may help them to judge whether a function which arises in a particular problem, and is not included among the known covariance or variogram models, is permissible as such a model. This is done by investigating the properties of the candidate model in both the space and frequency domains. This investigation covers stationary random functions as well as intrinsic random functions (i.e., nonstationary functions for which increments of some order are stationary). Then, based on the theoretical results obtained, a procedure is outlined and successfully applied to a number of candidate models. In order to give this procedure a more practical context, 'stereological' equations are employed that essentially transfer the investigations to one-dimensional space, together with approximations in terms of polygonal functions and Fourier-Bessel series expansions. There are many benefits and applications of such a procedure. Polygonal models can be fit arbitrarily closely to the data. Also, the approximation of a particular model in the frequency domain by a Fourier-Bessel series expansion can be very effective. (Murphy-IVI)
W84-03822

NONLINEAR STOCHASTIC MODEL OF RAINFALL RUNOFF PROCESS,

Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
S. G. Rao, and R. A. Rao.
Water Resources Research, Vol. 20, No. 2, p 297-309, February, 1984. 7 Fig, 7 Tab, 18 Ref. OWRT project C-3277.

Descriptors: *Nonlinear stochastic models, *Rainfall-runoff relationships, Rainfall, Runoff, Forecasting, Rough River, Kentucky.

A nonlinear stochastic model is proposed to model the rainfall runoff process in which higher order derivatives of rainfall are used in addition to the magnitude of rainfall as inputs. The rainfall, runoff, and derivatives of rainfall are considered as stochastic. The model consists of several subsystems in parallel. The first subsystem utilizes the observed rainfall and runoff as input and output, respectively. The subsequent subsystems use higher order derivatives of rainfall as input and forecast error from the previous subsystems as output. The subsystems improve the performance of the overall model by using higher order derivatives of input. The error in forecasting the runoff is progressively reduced by each subsystem. The method of analysis and parameter estimation of each of the subsystems are the same except that different inputs and outputs are used to characterize the subsystems. The optimal output of each of the subsystems is computed by minimizing the corresponding mean square error, and the estimation procedure is based on the statistical theory of filters involving the marginal and joint probability density functions of rainfall, runoff, and rainfall derivative sequences. The model is tested using daily rainfall runoff data from the Rough River basin in Kentucky. Testing the residuals of the model for whiteness is emphasized in order to improve the prediction performance of the model. (Murphy-IVI)
W84-03826

RAINFALL-RUNOFF IN SOIL EROSION WITH SIMULATED RAINFALL, OVERLAND FLOW AND COVER,

M. J. Singer, and P. H. Walker.
Australian Journal of Marine and Freshwater Research, Vol. 21, No. 2, p 109-22, 1983. 3 Fig, 6 Tab, 26 Ref.

Descriptors: *Rainfall-runoff relationships, *Soil erosion, *Simulated rainfall, *Overland flow, Straw cover, Agricultural runoff, Surface runoff, Rainfall impact, Rainfall intensity, Sheet erosion.

The relative importance of rainsplash, rain-flow transportation and overland flow alone in sheet erosion may be determined by using a flume and rainfall simulator with soil materials. The 20-100 mm portion of a yellow podzolic soil (Albaqualf) from the Ginninderra Experiment Station (A.C.T.) was used in a rainfall simulator and flume facility to elucidate the interactions between raindrop impact, overland water flow and straw cover as they affect soil erosion. A replicated factorial design compared soil loss in splash and runoff from 50 and 100 mm/h rainfall, the equivalent of 100 mm/h overland flow, and 50 and 100 mm/h rainfall plus the equivalent of 100 mm/h flow, all at 0, 40 and 80% straw cover on a 9% slope. As rainfall intensity increased, soil loss in splash and runoff increased. Within cover levels, the effect of added overland flow was to decrease splash but to increase total soil loss. This is due to an interaction between raindrops and runoff which produces a powerful detaching and transporting mechanism within the flow known as rain-flow transportation. Airsplash is reduced, in part, because of the changes in splash characteristics which accompany changes in depth of runoff water. Rain-flow transportation accounted for at least 64% of soil transport in the experiment and airsplash accounted for no more than 25% of soil transport. The effects of rainfall, overland flow and cover treatments, rather than being additives, were found to correlate with a natural log transform of the soil loss data. The findings have relevance to predictive models such as CREAMS which are based on erosional processes. (Murphy-IVI)
W84-03875

SMEMAX. CAUTION,

Missouri Univ.-Rolla. Dept. of Civil Engineering.
J. A. Westphal.
Journal of Hydraulic Engineering, Vol. 110, No. 3, p 209-218, March, 1984. 5 Tab, 7 Ref.

Descriptors: *SMEMAX, Model studies, Computer programs, Mathematical equations, Mathematical models, Mathematical studies, Flood data, Flood hydrographs, Comparison studies, Flood frequency.

The intrinsic appeal of SMEMAX is that it seems to obviate the need for choosing a 'best fit' distribution from among several possible options. The SMEMAX Transformation was tested on samples generated from log-Pearson Type III and Gumbel Extreme Value Type 1 distributions. Although the transformation results in a distribution with a skew near zero, it is not a true normal distribution. The coefficients of kurtosis for the transformed distributions are always less than three and when the parent distribution approaches a reverse-J shape, the transformed distribution is bimodal. When the skew coefficient of the logarithms of events is -0.5 or greater for samples from the log-Pearson Type III distribution, the SMEMAX procedure underestimates the magnitude of events with return periods of 50 yr and greater. Similarly, SMEMAX estimates of rare events from the Gumbel Extreme Value Type 1 distribution are always too low. Based on comparisons made in this study, it is likely that application of SMEMAX procedures to any skewed distribution will result in biased estimates of the magnitude of rate events and if the skew is positive the estimates will be too low. (Murphy-IVI)
W84-03916

SCS URBAN PEAK FLOW METHODS,

Maryland Univ., College Park. Dept. of Civil Engineering.
R. H. McCuen, W. J. Rawls, and S. L. Wong.
Journal of Hydraulic Engineering, Vol. 110, No. 3, p 290-299, March, 1984. 2 Fig, 4 Tab, 8 Ref.

Descriptors: *Hydrologic models, *Flood peak, Flood basins, Flood recurrence interval, Flood forecasting, Flood frequency, Maximum probable floods, Flood hydrographs, Flood plain management, Urban watersheds, Urban hydrology, Urban areas.

The peak flow hydrologic methods of the U.S. Soil Conservation Service (SCS) (as contained in their Technical Release No. 55) are widely used for planning and design on small urban watersheds. The urbanization factors of the TR-55 methods (i.e., the lag factors for the graphical method and the peak factors for the chart method) were apparently not directly based on analyses of measured data and have not previously been systematically tested. Therefore, the objective of this study was to test the TR-55 methods and recalibrate the urbanization factors if the methods were found to be biased. A data base was compiled for 51 small urban watersheds under 4,000 acres (1,600 ha) in the United States. The annual maximum flood series were used to develop Log-Pearson Type III frequency curves, from which peak discharge rates were estimated for the following return periods: 2-yr, 5-yr, 10-yr, 25-yr, 50-yr, and 100-yr. The bias and accuracy of the SCS methods were evaluated using the Log-Pearson Type III estimate as the expected true value. The results indicate that no urbanization correction factors are needed for the graphical methods when time of concentration is determined using the velocity method. The adjustment factor for the hydraulic length modification of the channel only, and the hydraulic length modification adjustment relationship is not a function of curve number. The curve for a curve number of 90 provides the most accurate prediction. (Murphy-IVI)
W84-03921

COLUMBIA RIVER HYBRID MODELING SYSTEM,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Estuaries Div.
W. H. McAnally, Jr., J. V. Letter, Jr., J. P. Stewart, W. A. Thomas, and N. J. Brogdon, Jr.
Journal of Hydraulic Engineering, Vol. 110, No. 3, p 300-311, March, 1984. 3 Fig, 13 Ref.

Descriptors: *Columbia River, *Model studies, Mathematical models, Shoals, Sedimentation, Sediment control, Sediment transport, Forecasting, Hydrologic models, Oregon.

The Army Corps of Engineers maintains a 48-ft deep by 2,600-ft wide navigation channel through the estuary entrance of the Columbia River, Oregon, which is protected by jetties. Annual maintenance dredging of 4,800,000 cu yd in the entrance has led the Army Engineer District, Portland (NPP), to seek means of reducing shoaling in the entrance channel. A hybrid modeling method for predicting waterway sedimentation was developed and applied to the Columbia River estuary. The method uses physical hydraulic models, two dimensional (2-D) numerical models, and analytical techniques in an integrated solution scheme. The hybrid modeling system consisted of a large physical model of the estuary, RMA-2V, a depth-integrated numerical model for sediment transport, and a collection of analytical methods. By using each method to address those phenomena that it is best able to describe, an improved modeling technique is created. (Murphy-IVI)
W84-03922

COMPLEX POLYNOMIAL APPROXIMATION OF THE LAPLACE EQUATION,
California Univ., Irvine. Dept. of Civil Engineering.
T. V. Hromadka, II, and G. L. Guymon.
Journal of Hydraulic Engineering, Vol. 110, No. 3, p 329-339, March, 1984. 7 Fig, 1 Tab, 10 Ref.

Descriptors: *LaPlace Equation, *Mathematical equations, *Polynomials, Surface flow, Porous media, Groundwater, Hydrologic model, Boundary conditions, Freezing, Frozen ground, Soil-water freezing.

A method of approximating the solution of the LaPlace equation in two-dimensions is presented. The numerical approach is to determine a complex variable polynomial which satisfies the specified boundary conditions along a simple closed contour. Since the method is simple to apply to time-stepped, quasi-steady state saturated ground water problems or moving boundary problems, a significant savings in computational effort over other boundary integral equation methods is available. Applications to a free water surface problem and a moving boundary problem are presented. Error bounds and model stability are considered. (Author's abstract)
W84-03924

GENERALIZED MODEL FOR STORMWATER RUNOFF HYDROGRAPHS,
New Jersey Agricultural Experiment Station, New Brunswick.
C. G. Uchrin, and W. J. Weber, Jr.
Journal of Environmental Science and Health, Vol. A19, No. 1, p 67-82, 1984. 7 Fig, 5 Tab, 4 Ref.

Descriptors: *Model studies, *Runoff, *Hydrographs, Storms, Rainfall-runoff relationships, Drainage basins, Rainfall distribution, Michigan.

The most direct method for obtaining detailed stormwater runoff quantity and quality for specific drainage areas is by direct sampling and analysis, but this is often impossible to perform this for all inputs to a receiving water body. An empirical model is presented for generating runoff hydrographs for nationwide drainage basins as a function of the drainage area, population density, and rainfall excess distribution. A computer program was written incorporating the analysis. The model was applied to a study area in southeastern Michigan. A water quality model was constructed for the Huron River-Ford Lake-Belleville Lake system. Detailed sampling and analysis of each storm drain input source was unfeasible, so the runoff quantity model described was used in conjunction with a separate quality submodel to generate time variable pollutant loadings. (Baker-IVI)
W84-03954

PREDICTIVE AGGREGATION MODELS IN HYDROLOGY,
Technical Univ. of Istanbul (Turkey).
Z. Sen.
Nordic Hydrology, Vol. 14, No. 1, p 19-32, 1983. 4 Fig, 1 Tab, 22 Ref.

Descriptors: *Model studies, *Hydrologic models, Prediction, Stochastic processes, Rainfall-runoff relationships, Flow.

A predictive aggregation model with recursive parameter estimations has been proposed. Necessary estimation formulations have been explicitly derived and then applied to monthly flows. The estimation procedure does not impose any restrictions concerning either the parameter matrices such as positive semidefiniteness or the standardization of observations to have zero mean. The estimations are unbiased and have the minimum variance as properties of the Kalman filter. The overall advantages of the model are that the computations are based on simple matrix algebra, that there is no need for an inverse matrix operation provided that the measurement matrix is scalar, that the parameters and states are estimated online as the data becomes available, that there is no need to preserve all the data in the computer memory, and that computations can be performed in a short time. Lower-order events can be generated which add up the the given higher-order events without any external intervention. (Baker-IVI)
W84-03973

KALMAN FILTER EMPIRICAL FITTING ON MONTHLY RAINFALL-RUNOFF RESPONSES,
National Technical Univ., Athens (Greece).
M. Mimikou.
Nordic Hydrology, Vol. 14, No. 2, p 93-112, 1983. 8 Fig, 4 Tab, 7 Ref.

Descriptors: *Rainfall-runoff relationships, *Kalman filters, Statistical methods, Model studies, Prediction, Runoff, River basins, Rivers, Greece, Aliakmon River, Acheloos River, Snowfall.

The majority of the methods for fitting rainfall-runoff Kalman filters use the statistical characteristics of the input (rainfall) and the output (runoff) series according to the systems analysis and control theory methodology. The presented empirical method of fitting takes into account additional input information and improves the knowledge about the hydrological system, without changing the simple two-variable structure of the filter. This information consists of the percentage of snowfall into the monthly basin rainfall, the magnitude of basin rainfall at month t in comparison to the rainfall at month t-1 (increasing, constant, or decreasing) and the amount of basin rainfall associated with basin's moisture and runoff characterisics. The Kalman filter empirically fitted on monthly rainfall-runoff responses of the Alaikmon and Acheloos river basins in Greece is shown to be more accurate and adequate than the automatically fitted filter by using conventional statistical methods. The filter has been used in hydroelectric energy studies of the area, where accurate runoff estimation from rainfall was necessary. (Baker-IVI)
W84-03980

COMPUTER CONTROL FOR IRRIGATION-CANAL SYSTEM,
Stone and Webster Engineering Corp., Denver, CO.
D. D. Zimbelman, and D. D. Bedworth.
Journal of Irrigation and Drainage Engineering, Vol. 109, No. 1, p 43-59, March, 1983. 10 Fig, 1 Tab, 16 Ref.

Descriptors: *Irrigation canals, *Computer models, Computers, Algorithms, Water conveyance, Open-channel flow, Water distribution, Comparison studies.

The objective was to develop an algorithm for the computerized control of an open-channel water distribution system that would allow the system to be operated on a demand basis rather than on a scheduled basis. The algorithm, which was of necessity empirical, is an adaption of proportional downstream control. The input to algorithm is the water surface upstream of each control structure. The output from the algorithm is an adjustment in gate opening, implemented at the adjacent upstream control structure. The adequacy of the algorithm was verified by simulating the interaction between the algorithm and two different typical canal systems. These simulations were used to first establish viability of the algorithm in an automated control environment, and secondly to compare automated control to manual control. The control algorithm is capable of controlling an open-channel water distribution system at a higher level of efficiency than manual control. Efficiency, under manual control, is measured in terms of the stability of the water surface elevations within the system. (Murphy-IVI)
W84-04037

PRECIPITATION AND RUNOFF ON EIGHT NEW ENGLAND BASINS DURING EXTREME WET AND DRY PERIODS,
Science and Education Administration, University Park, PA. Northeast Watershed Research Center.
R. J. Deangelis, J. B. Urban, W. J. Gburek, and M. A. Contino.
Hydrological Sciences Journal, Vol. 29, No. 1, 1984. 7 Fig, 4 Tab, 23 Ref.

Descriptors: *Precipitation, *Rainfall-runoff relationships, New England, Runoff, Seasonal variations, Watersheds, Evapotranspiration, Sleepers River Watershed, Vermont.

Extreme wet and dry 12 month periods occurred during the 20 years of hydrological data collections made at the Sleepers River Watershed (Vermont). Extrapolation of a nearby 87-year precipitation record to the basin was useful in determining the deviations of those extreme periods from normal. Seasonal water-input and runoff increased with elevation for both the wet and the dry period. For both water-input and runoff, the rate of increase was greater during the wet period. The slope of the water-input and runoff regression lines is related to the magnitude of the water-input. Variations in the measured flow at the eight subbasins examined were due to the complex basin and climatological conditions typical of New England

basins. However, the variations may be adequately described using elevation alone as the index. The fact that the increase in summer precipitation with elevation was significantly greater than the increase in runoff suggests that evapotranspiration increased with elevation. The greater magnitude of precipitation at higher elevations results in more potential and thus more actual evapotranspiration. (Baker-IVI)
W84-04067

WATER, SEDIMENT AND NUTRIENT MOVEMENT IN FORESTED AND NON-FORESTED CATCHMENTS IN KUMAUN HIMALAYA,
Kumaun Univ., Naini Tal (India). Dept. of Botany.
A. N. Pandey, P. C. Pathak, and J. S. Singh.
Forest Ecology and Management, Vol. 7, No. 1, p 19-29, November, 1983. 6 Tab, 16 Ref.

Descriptors: *Forest soils, *Overland flow, *Soil loss, *Nutrients, *Himalaya, Soil deposition, Landslides, Cultivation, Monsoons, Vegetation, Storm seepage, Calcium, Potassium, Phosphorus, Nitrogen.

Overland flow, and soil and nutrient loss were assessed for four sites under original forest cover, and for four sites affected by soil deposition, landslide or cultivation in the Kumaun Himalaya during the 1981 and 1982 monsoon seasons. Overland flow was positively related with rainfall quantity and intensity and was reduced by the growth of ground vegetation during the later months of the monsoon season. Average overland flow was only 0.50% of the total incident rainfall indicating that these catchments are subsurface flow systems. Soil loss was positively related with overland flow, both being greater for non-forested compared to forested sites. Rainfall added a significant amount of nutrients. This extra system input was greater than loss through overland flow and runoff soil. The forested sites lost less nutrients compared to non-forested sites. The loss of nutrients was in the order: Ca > K > P > N. The forests of the catchments in Himalaya should be protected to avoid the impairment of hydrologic processes. (Author's abstract)
W84-04128

EFFICIENT AND ROBUST METHOD FOR ESTIMATING UNIT HYDROGRAPH ORDINATES,
University Coll., Galway (Ireland). Dept. of Engineering Hydrology.
M. Bruen, and J. C. I. Dooge.
Journal of Hydrology, Vol. 70, No. 1-4, p 1-24, 1984. 11 Fig, 19 Ref, 2 Append.

Descriptors: *Unit hydrographs, *Smoothed least squares, Mathematical studies, Flood hydrographs, Matrix structure, Computers, Hydrographs.

The coefficient matrix for the 'normal equations' for least-squares estimates of discrete unit hydrographs (DUH) is symmetric Toeplitz. Smoothed least squares is an effective way of combating the instability of DUH estimates due to numerical ill-conditioning. This matrix structure can be used to reduce both the data storage and arithmetic computation requirements of computer programs for estimating DUHs. The method is particularly useful for small computers when memory space is limited or when large amounts of data are involved. The algorithm can be used to provide smoothed least-squares estimates of the DUH using a single extra arithmetic addition. Estimates of DUH's for multiple-event data can easily be calculated. This method gives the user a degree of control over the estimation process which allows the exercise of subjective judgement. Computer programs are presented for both the single-event and multiple-event case. The utility of the smoothed estimates is illustrated using real data which would give unrealistic ordinary least-squares estimates. The data are for three separate flood events in the Almond and Almondell, Scotland catchment. The catchment has an area of 229 sq km. (Moore-IVI)
W84-04140

STATISTICAL ANALYSIS OF WEATHER-TYPE RUNOFF PHENOMENA IN AN ALPINE ENVIRONMENT,
Vrije Univ., Amsterdam (Netherlands). Inst. of Earth Sciences.
A. A. Van de Griend, and E. Seyhan.
Journal of Hydrology, Vol. 70, No. 1-4, p 51-69, 1984. 11 Fig, 2 Tab, 11 Ref.

Descriptors: *Alpine regions, *Weather, *Runoff, *River Ahr, *Italy, Precipitation, Temperature, Snowmelt, Glaciers, Temporal distribution, Atmospheric circulation, Autocorrelation.

Each class of weather types has its own characteristic population of daily runoff data and sequences of daily runoff. In order to obtain a better insight into the combined effect of weather types working on the complex hydrologic system, several aspects of runoff were analyzed with respect to the distribution of daily runoff occurrences and their time sequence. For this purpose, atmospheric circulation types were classified into hydrologically relevant classes of weather types using a classification developed for the European Alpine region. Hydrologic and meteorological data from the 23-yr period 1953-1975 for the Alpine pluvio-nivo-glacial catchment of the River Ahr (Italy) were used for the analyses. Antecedent hydrologic conditions are subject to large year-to-year changes, especially during the months with snow- and glacier-melt. The magnitude of runoff during each particular class of weather types is largely governed by autocorrelation (related to the characteristic times of the systems active during preceding classes and thus related to the preceding weather types) and by antecedent conditions, rather than by the weather types themselves. The influence of a weather class displays a distinct dependency of the time elapsed since the start of the particular class. On the average, the influence does not become manifest until after a 2-3 day period. (Moore-IVI)
W84-04142

2B. Precipitation

NEW TECHNIQUE FOR THE ANALYSIS OF EXTREME RAINFALL WITH APPLICATION TO LAGOS METROPOLIS, NIGERIA,
Lagos Univ. (Nigeria). Faculty of Engineering.
E. S. Oyegoke, and J. O. Sonuga.
Nordic Hydrology, Vol. 14, No. 3, p 127-138, 1983. 2 Fig, 6 Tab, 9 Ref.

Descriptors: *Rainfall, *Storm runoff, *Statistical analysis, *Lagos, *Nigeria, Storms, Entropy, Urban areas, Simulation.

A case study is made of storm rainfall analysis for Lagos metropolis using the available rainfall data for Ikeja, Oshodi and Lagos Mainland. The principle of maximum entropy is viewed as an alternative technique for the parameter estimation of the Extreme Value Type-1 (EV1) distribution or Gumbel distribution often used for the analysis and forecast of extreme events. For comparison purposes, the parameters of the EV1 distribution are also obtained using the Maximum Likelihood Method, the latter being one of the most reliable techniques and perhaps the most widely used for parameter estimation of the EV1 distribution. This exercise makes it possible to demonstrate in some ways the superiority of the maximum entropy method over existing methods used for statistical simulation of extreme events. (Baker-IVI)
W84-03982

REGIONAL RAINFALL CHEMISTRY IN MINNESOTA AND WEST CENTRAL WISCONSIN,
Minnesota Univ., St. Paul. Dept. of Plant Pathology.
G. C. Pratt, M. R. Coscio, and S. V. Krupa.
Atmospheric Environment, Vol. 18, No. 1, p 173-182, 1984. 3 Fig, 5 Tab, 32 Ref.

Descriptors: *Rainfall, *Water pollution effects, *Minnesota, *Wisconsin, *Water chemistry, *Acid rain, Sulfates, Nitrates, Ammonium, Calcium, Acidity.

During May-October 181, automatic, refrigerated, sequential, precipitation samplers were operated at seven locations in Minnesota and Wisconsin. Sites were dispersed in the study area to sample within three major types of ecosystems found in the region. At the northeastern Minnesota sites, an area considered vulnerable to acidic precipitation, concentrations of all major ions except hydrogen were generally lower than at other sites. The higher rainwater acidity at the northern sites appears to be a function of the lower concentrations of alkaline cations such as calcium (2+) ions and ammonium. However, the best single predictor of acidity was sulfate. So-called clean rain may be slightly more acidic than pH 5.6, as indicated by the analysis of the relationships between pH and concentrations of the major ions. Air parcel back trajectories showed that rain in air masses arriving from the northwest quadrant contained the lowest concentrations of sulfate and nitrate, while the majority of rainfall sulfate and nitrate arrived from the south quadrant. (Baker-IVI)
W84-04062

CENTRAL KANSAS FLASH FLOODS OF JUNE 1981,
National Weather Service Forecast Office, Topeka, KS.
For primary bibliographic entry see Field 2E.
W84-04064

STUDY FOR IMPROVING PRECIPITATION OCCURRENCES MODELLING WITH A MARKOV CHAIN,
National Technical Univ., Athens (Greece).
M. Mimikou.
Journal of Hydrology, Vol. 70, No. 1-4, p 25-33, 1984. 1 Fig, 3 Tab, 7 Ref.

Descriptors: *Precipitation, *Markov chain, *Mathematical models, *Greece, Stochastic process, Seasonal variation, Simulation.

Daily precipitation occurrences and their monthly wet-days' sums of seven precipitation stations in Greece are modelled with a Markov chain of seasonally varying order. A method is proposed based on the conjunctive use of a low-order autoregressive stochastic model with a Markov chain, which significantly improves the Markov chain's efficiency for modelling daily precipitation occurrences and their monthly wet-days' sums. With the proposed method for modifying the generation procedure with a Markov chain, not only the monthly wet-days' sums but also the daily precipitation occurrences modelling are significantly improved. The improvement is expected, since this procedure utilizes more information from the historical data; the standard deviation of the sum of wet days is indirectly taken into account. The modified dry day-wet day simulation sequences represent better the historical sequences than the unmodified ones. This is due to the successful selection of the correct criterion for properly distributing inside the month the added or subtracted wet days, than to the additional historical monthly statistical information which is brought into the model. (Moore-IVI)
W84-04141

2C. Snow, Ice, and Frost

ICE FORECASTING MODEL FOR LAKE ERIE,
Ecology and Environment, Inc., Buffalo, NY.
S.-H. Chieh, A. Wake, and R. R. Rumer, Jr.
Journal of Waterway, Port, Coastal and Ocean Engineering, Vol. 109, No. 4, p 392-415, November, 1983. 14 Fig, 23 Ref. Great Lakes Environmental Research Laboratory contract NA80RAC00148.

Descriptors: *Lake ice, *Forecasting, *Lake Erie, Navigation, Model studies, Mathematical models, Thermodynamics, Wind, Ice cover, Ice drift, Iced lakes.

A previously developed Great Lakes ice forecasting model for winter navigation aid has been calibrated using observed data from specific Lake Erie

ice transport events. The model is based on the macroscopic continuum hypothesis for the fragmented ice field and the internal ice stress is represented by a viscous-plastic type constitutive law. The external driving force includes the time-dependent wind and water current fields as well as the thermodynamic source/sink terms for the ice mass conservation. By adjusting the model coefficients employed in the constitutive equations and the thermodynamic factors, the computed results are in reasonable agreement with the short-term observations for the 1978-79 ice season in Lake Erie. Major findings include the profound effects of the wind-driven water currents and the ice melt at the ice-water interface on the ice regime of Lake Erie during the late stage of the ice season. (Author's abstract)
W84-03797

SOLUTE REDISTRIBUTION DURING NORMAL FREEZING,
Iowa Univ., Iowa City.
For primary bibliographic entry see Field 5B.
W84-03831

CORRECTION OF MEASURED PRECIPITATION IN THE ALPS USING THE WATER EQUIVALENT OF NEW SNOW,
Eidgenoessische Technische Hochschule, Zurich (Switzerland).
B. Sevruk.
Nordic Hydrology, Vol. 14, No. 2, p 49-58, 1983. 3 Fig, 3 Tab, 14 Ref.

Descriptors: *Precipitation, *Measuring instruments, *New snow, *Alps, Temperature effects, Wind, Snowfall, Air temperature.

Considerable systematic losses in winter precipitation measurements in the Alps, using heated and storage gauges, show that corrections of precipitation data are a necessity. For storage gauges the losses are related to wind speed measured near the gauge site. For heated gauges the losses are more complex due to heating and blowing out of snow. The Hellmann heated siphon pluviograph with wind shield showed 56% less winter precipitation than measured on a snow board at an altitude of 2,540 m a.s.l. For the Swiss heated tipping bucket gauge and the storage gauge, precipitation was 31% less. Rough assessments can be made from the portion of snowfall on days with the temperature less than minus 8 degrees C. The results can be used to make a preliminary adjustment of precipitation sums at Alpine gauge sites where wind speeds and temperature can be assessed. (Baker-IVI)
W84-03976

GROWTH MODEL FOR BLACK ICE, SNOW ICE AND SNOW THICKNESS IN SUBARCTIC BASINS,
Merentutkimuslaitos, Helsinki (Finland).
M. Lepparanta.
Nordic Hydrology, Vol. 14, No. 2, p 59-70, 1983. 5 Fig, 1 Tab, 22 Ref.

Descriptors: *Ice thickness, *Model studies, *Subarctic zone, Snow, Ice, Black ice, Density, Temperature, Snowfall, Heat flux.

A model is presented for the growth of ice thickness in autumn and winter. The model includes packing of snow and snow-snow ice transformation. The external input variables include the temperature of the upper surface of the ice sheet, and snowfall and heat flux from the water. Snow-covered floating ice sheet has three distinct layers of frozen water: black ice, snow ice (frozen slush), and snow. Black ice is formed from basin water only. The model predicts the thickness of black ice, snow ice and snow and the density of snow. Thermal inertia is neglected. The results are sensitive to the assumed density of freshly fallen snow and the formulation of snow metamorphism. Comparisons between observations and model calculations are given. The agreement is moderate and the need for field work on snow and ice is noted. The maximum annual ice thickness under varying external conditions is discussed. The model places emphasis on snow metamorphism and tranformation of snow into snow ice as these processes are of great importance in subarctic regions. (Baker-IVI)
W84-03977

SNOWPACK LIQUID WATER DETERMINATIONS USING FREEZING CALORIMETRY,
Resource Consultants, Inc., Fort Collins, CO.
E. B. Jones, A. Rango, and S. M. Howell.
Nordic Hydrology, Vol. 14, No. 3, p 113-126, 1983. 5 Fig, 28 Ref. Contract NAS5-22312, NAS5-23815, NAS5-26062.

Descriptors: *Calorimetry, *Snowpack, Measuring instruments, Forecasting, Runoff, Avalanches, Water supply.

Liquid water in a snowpack, although recognized for some time as a quantifiable parameter of hydrological significance, is not a regularly reported snowpack characteristic due to difficulties with its measurement in the field. Freezing calorimetry is discussed from presentation of theory through the application of the method including formulations for calculating the percent of liquid water in a snowpack. The freezing or cold calorimeter technique was selected primarily because it is relatively inexpensive, it is simple to use, and it is based on known and documented physical phenomena. Because a small amount of liquid water is frozen in the freezing calorimetric approach as opposed to a large amount of ice melted in the melting calorimetric method, the freezing method is more sensitive to variations in liquid water content. Silicon oil has been used successfully as the freezing agent. Consistent results can be obtained with the method, even when using newly-trained operators. Liquid water content data can be obtained approximately every 15 minutes when using two calorimeters and three operators. The freezing calorimetric approach was accurate in determining the liquid water content of the snow to within 1.0 to 2.0% by weight. (Baker-IVI)
W84-03981

2D. Evaporation and Transpiration

EFFECTS OF VEGETATION CONVERSION UPON WATER USE BY RIPARIAN PLANT COMMUNITIES,
Arizona Univ., Tucson. School of Renewable Natural Resources.
L. W. Gay.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-153519, Price codes: A09 in paper copy, A01 in microfiche. Completion Report, January, 1984. 175 p, 18 Fig, 14 Tab, 34 Ref, 9 Append. Project No. OWRT B-084-ARIZ (1), Contract/Grant No. 14-34-0001-9146.

Descriptors: *Evapotranspiration, *Consumptive use, *Phreatophytes, Colorado River, Plant communities, Saltcedar, Data collection, Bowen ratio system, Measurement.

Evapotranspiration was measured at two points simultaneously over a dense stand of saltcedar on the lower Colorado River with a computerized, portable Bowen ratio system. Twenty-one days of good ET data were collected during two successive years on eight different expeditions within the April-November growing season. In addition, potential ET (PET) estimates were developed for four models (radiaton, radiation and temperature, net radiation and Penman combination) using climatological data from two weather stations at nearby Blythe, California. ET from the saltcedar ranged up above 12 mm per day in midsummer. The March 23-Nov. 11 growing season total was estimated from these measurements to be 1677 mm, including 40 mm of evaporated precipitation, and annual total ET was estimated to be 1727 mm. The climatological estimates of PET were converted to actual ET (AET) by a 4th-order calibrating function developed by regressing daily totals of measured Bowen ratio ET against estimated PET. Seasonal totals of AET were in excellent agreement and averaged 1756 mm. There was little difference between the two years. The two approaches suggest that 1750 and 1800 mm are reasonable figures for growing season ET and for annual ET from well-developed saltcedar on the lower Colorado. A simple radiation model appears suitable for estimating seasonal AET totals in this region if weather data are limited, and direct measurements of ET are lacking. The report describes the instrumentation, measurements and analysis techniques needed to develop measurements of AET from climatological estimates of PET.
W84-03661

MODELLING DAILY EVAPOTRANSPIRATION USING REMOTELY SENSED DATA,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
For primary bibliographic entry see Field 7B.
W84-03790

BARE-SOIL EVAPORATION DETERMINED IN SITU BY INFRARED THERMOMETRY,
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
J. Ben-Asher, A. W. Warrick, and A. D. Matthias.
Journal of Hydrology, Vol. 69, No. 1-4, p 325-334, February, 1984. 8 Fig, 5 Ref.

Descriptors: *Evaporation, *Infrared thermometry, Surface temperature, Wind velocity, Model studies, Parametric hydrology, Hydrologic budget.

Soil properties exhibit random spatial fluctuations and most irrigation methods are systematically non-uniform. Thus the only way to account for the randomness of natural soil variations and the gradual changes in water application is to describe its components statistically instead of deterministically. This can be achieved by expressing the water balance equation terms as random variables. Bare-soil evaporation was measured in situ by infrared thermometry. Measurements were made at 25 sites on a 20 x 20-m plot. About 17 mm of water were added during the first test in March 1982 and 27 mm during a second experiment in May, both in a rainless and sunny period. The method requires measurement of wind speed, the maximum surface temperature of the test soil and a reference dry surface. Measured values of the evaporation were well correlated (r to the 2 power = 0.7) with water added, and the amount of evaporation measured for a 1-week period was of the same order of magnitude as the added water. Supporting information of surface water content by gravimetric and neutron measurements helped to complete water-balance calculations on each site. The method is proposed as a tool for evaluating spatial variability for water-balance studies in large areas. Semi-variograms were prepared for evaporation on the site and fitted by assuming a linear drift. (Murphy-IVI)
W84-03791

EVAPORATION FROM A BARE SOIL EVALUATED USING A SOIL WATER TRANSFER MODEL AND REMOTELY SENSED SURFACE SOIL MOISTURE DATA,
Centre de Recherches en Physique de l'Environnement, Issy-les-Moulineaux (France).
L. Prevot, R. Bernard, O. Taconet, and D. Vidal-Madjar.
Water Resources Research, Vol. 20, No. 2, p 311-316, February, 1984. 9 Fig, 2 Tab, 7 Ref.

Descriptors: *Evaporation, *Soil water, *Model studies, *Remote sensing, Hydrologic budget, Evapotranspiration, Boundary conditions, Rainfall.

Actual evapotranspiration is an important quantity in climatology, hydrology, and agronomy but its characterization at regional scale appears to be rather difficult. Remote sensing techniques, which are well suited for large-scale measurements, might allow a regional approach to evaporation. A soil water transfer model has been used to estimate the soil water budget and evaporation using remotely sensed surface soil moisture data, with accuracy comparable to that of neutron probe measurements, without rain simulation. The with rain model yielded inferior estimates of evaporation and

water budget due partly to numerical difficulties but also to the lack of radar data between the rain events. Daily surface soil moisture data, obtained with a C band scatterometer on a bare soil, provide the upper boundary condition for the model which uses an implicit finite difference scheme to solve the nonlinear Richards equation. The soil is represented by two layers differing in hydraulic conductivity. (Baker-IVI)
W84-03827

WATER TRANSFER IN PLANTS; I. - SCALE MODELLING OF PLANT CANOPY IN NATURAL CONDITIONS (TRANSFERT HYDRIQUE DANS LE VEGETAL I. - MODELISATION A LECHELLE DU COUVERT VEGETAL EN CONDITIONS NATURELLES),
Institut National de la Recherche Agronomique, Versailles (France). Station de Bioclimatologie.
N. Katerji, M. Hallaire, A. Perrier, and R. Durand.
Acta Oecologia-Oecologia Plantarum, Vol. 4, No. 1, p 11-26, 1983. 6 Fig, 3 Tab, 25 Ref.

Descriptors: *Transpiration, *Plant water potential, Water storage, Water loss, Transport depletion, Alfalfa, Model studies, Canopy.

Measurements made in a field of alfalfa of hourly transpiration rate and of the corresponding difference between soil and foliage water potential, showed a non-linear relation. Similar results have been reported by others and, from these, it has been concluded that the plant resistance to liquid flow is not constant, but tends to decrease as the flow-rate increases. However, an analysis of the data with a model that includes a water storage reservoir of variable content in the plant system, showed that the actual absorption (transpiration minus, the contribution of the reservoir-plant), rather than the rate of water loss from the crop, closely adheres to a linear model. Hence, the hydraulic resistance is shown to be constant, with a value of about 25 bar h/mm for an alfalfa crop of LAI around 3. In an appendix the method for deriving the model parameters is given in detail, together with an error analysis. (Author's abstract)
W84-03871

WATER TRANSFER IN PLANTS; II. - FIELD DETERMINATION OF PLANT CANOPY WATER CONTENT VARIATIONS, (TRANSFERT HYDRIQUE DANS LE VEGETAL; II. - DETERMINATION AU CHAMP DES VARIATIONS DE CONTENU EN EAU DU COUVERT VEGETAL),
Institut National de la Recherche Agronomique, Versailles (France). Station de Bioclimatologie.
N. Katerji, M. Hallaire, Y. Menoux-Boyer, and A. Perrier.
Acta Oecologia-Oecologia Plantarum, Vol. 4, No. 2, p 171-181, 1983. 7 Fig, 21 Ref.

Descriptors: *Water transfer, *Canopy, Plant water potential, Lucerne, Water vapor, Water loss, Hydrologic cycle, Water deficit.

A previously presented model for water circulation within plants suggested a method for determining, from transpiration and water potential measurements, the amounts of water lost and recovered during the course of the day by the plant canopy. Applied to a lucerne canopy over a period of about twenty days, this method led to a set of plausible results which thus seem to comfirm the model's validity. As opposed to the case of other methods which apply only to the aerial parts, the data obtained here includes the root system contribution; for lucerne canopy studied, this contribution corresponds to two third of the water lost by the plant. The possibilities of increasing accuracy while simultaneously simplifying measurements are examined, as well as possible limitations in the method's application notably in the case of great soil dryness. (Murphy-IVI)
W84-03874

EVAPORATION REDUCTION: SUMMARY OF LONG-TERM TANK STUDIES,
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
For primary bibliographic entry see Field 3B.
W84-04039

EVAPORATION FROM SALINE LAKES: A COMBINATION EQUATION APPROACH,
Institute of Hydrology, Wallingford (England).
I. R. Calder, and C. Neal.
Hydrological Sciences Journal, Vol. 29, No. 1, p 89-97, 1984. 3 Fig, 2 Tab, 18 Ref.

Descriptors: *Saline lakes, *Evaporation, *Model studies, Mathematical equations, Dead Sea, Lakes, Temperature effects, Solutes, Solubility.

A modification is made to the conventional evaporation equation to allow the calculation of evaporation from saline lakes. The modified equation shows how, for a given set of metecrological conditions, the evaporation rate, the partitioning of available energy into sensible and latent heat, and the surface temperature, can all be related to solute concentrations. To illustrate the operation of the equation the recent and proposed changes to the hydrology of the Dead Sea were used as a case study. The meteorological inputs to the model cannot, however, be considered to be wholly independent of the activity of the water in solution. A decrease in lake temperature, caused by an increase in the activity of water in solution, will reduce long-wave back radiation from the lake thereby increasing net radiation, changing the atmospheric stability conditions and increasing the aerodynamic resistance, and modifying to some extent the temperature and humidity of the air above the lake. The magnitude of the model prediction errors will be largely determined by the uncertainties in the measurement of the meteorological input data and the estimate of the aerodynamic resistance. It is unrealistic to assume an accuracy of better than perhaps 10-15% in any of the quantities, which will result in model prediction errors of at least a similar magnitude. (Baker-IVI)
W84-04072

BLANEY-MORIN-NIGERIA EVAPOTRANSPIRATION MODEL,
Ahmadu Bello Univ., Zaria (Nigeria). Dept. of Agricultural Engineering.
J. O. Duru.
Journal of Hydrology, Vol. 70, No. 1-4, p 71-83, 1984. 3 Fig, 4 Tab, 12 Ref.

Descriptors: *Evapotranspiration, *Mathematical models, *Nigeria, Temperature, Relative humidity, Solar radiation, Wind, Developing countries.

In Nigeria, and perhaps in other developing countries, there is a need to compute evapotranspiration (Et) from those meteorological parameters which can be easily measured. An evapotranspiration model has been developed for application in Nigeria. The model, designated as the Blaney-Morin-Nigeria evapotranspiration model, predicts potential evapotranspiration with accuracy and consistency that are better than the Penman model, under Nigerian conditions. The proposed model implies that, under Nigerian conditions, accurate prediction of Et can be obtained from temperature, relative humidity and radiation. The effect of wind can be ignored without much loss of accuracy. This can be seen from the fact that the Blaney-Morin-Nigeria model proved to be a better predictor than the Penman model, which considers wind effects, in both a high-wind region and a low-wind region. The Blaney-Morin evapotranspiration concept may have similar potential elsewhere when given specific form with appropriate constants derived to reflect climatic peculiarities. (Moore-IVI)
W84-04143

WATER LOSS AND MALATE FLUCTUATIONS DURING THE DAY FOR PLANTS IN THE SOUTHERN NAMIB DESERT,
Bayreuth Univ. (Germany, F.R.).
For primary bibliographic entry see Field 2I.
W84-04176

2E. Streamflow and Runoff

INITIAL ASSESSMENT OF TIME OF TRAVEL AND MIXING THROUGH GULF ISLAND POND AND THE LOWER ANDROSCOGGIN RIVER, MAINE,
Geological Survey, Augusta, ME. Water Resources Div.
G. W. Parker, and S. Hunt.
Available from the Ofss, USGS, Lakewood, CO 80225, Price: $7.75 paper copy, $3.50 microfiche. USGS Water-Resources Investigations Report 83-4020, 1983. 53 p, 38 Fig, 6 Tab, 8 Ref.

Descriptors: *Rivers, *Marking techniques, *Reservoir, *Mixing, Hydrology, Streamflow, Tracer, Stratification, Inflow, Unsteady flow, Stratified flow, Analysis, Fluorometry, *Maine, *Time-of-travel, Androscoggin River, Gulf Island Pond.

Flow-stratification patterns were observed in Gulf Island Pond during time-of-travel studies in May and August 1980. The stratification patterns in this 70 million cubic-meter impoundment were due to a temperature differences between inflowing water and reservoir water. Separation was observed at temperature differences of 0.5 degrees C in May 1980 and 1.0 degrees C in August 1980. The pathway taken by inflowing water through the reservoir was governed by the temperature-related density forces acting between the two water masses. Data collected during August 1980 to define differences in dye concentrations with depth at two fixed profile points in Gulf Island Pond showed average water velocity to be seven times faster near the bottom than near the surface. A concept of mass flow was used to analyze data collected at sites downstream from Gulf Island Dam where flow varied rapidly with time. This report presents the mathematical derivation of controid traveltime, skewness, and percentage recovery of dye mass as determined from mass versus time curves. (USGS)
W84-03552

MEAN ANNUAL RUNOFF AND PEAK FLOW ESTIMATES BASED ON CHANNEL GEOMETRY OF STREAMS IN NORTHEASTERN AND WESTERN MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
C. Parrett, R. J. Omang, and J. A. Hull.
USGS Water-Resources Investigations Report 83-4046, June, 1983. 53 p, 8 Fig, 8 Tab, 24 Ref.

Descriptors: *Annual runoff, Regression analysis, Estimating equations, Peak discharge, *Mean flow, Gaging station, Active-channel width, Bankfull width, *Channel geometry, *Montana.

Equations for estimating mean annual runoff and peak discharge from measurements of channel geometry were developed for western and northeastern Montana. The study area was divided into two regions for the mean annual runoff analysis, and separate multiple-regression equations were developed for each region. The active-channel width was determined to be the most important independent variable in each region. The standard error of estimate for the estimating equation using active-channel width was 61 percent in the Northeast Region and 38 percent in the West region. The study area was divided into six regions for the peak discharge analysis, and multiple regression equations relating channel geometry and basin characteristics to peak discharges having recurrence intervals of 2, 5, 10, 25, 50 and 100 years were developed for each region. The standard errors of estimate for the regression equations using only channel width as an independent variable ranged from 35 to 105 percent. The standard errors improved in four regions as basin characteristics were added to the estimating equations. (USGS)
W84-03556

ESTIMATED NATURAL STREAMFLOW IN THE RIO SAN JOSE UPSTREAM FROM THE PUEBLOS OF ACOMA AND LAGUNA, NEW MEXICO,

Geological Survey, Albuquerque, NM. Water Resources Div.
D. W. Risser.
USGS Water-Resources Investigations Report 82-4096, 1982. 51 p, 10 Fig, 6 Tab, 16 Ref.

Descriptors: *Streamflow, *Streamflow depletion, *Reservoir evaporation, Rainfall-runoff relationships, Springs, Surface water records, *New Mexico, Pueblo of Laguna, Pueblo of Acoma, Bluewater Lake.

The development of surface and ground water, which began about 1870 in the upper Rio San Jose drainage basin, has decreased the flow of the Rio San Jose on the Pueblo of Acoma and the Pueblo of Laguna. The purpose of this study was to estimate the natural streamflow in the Rio San Jose that would have entered the pueblos if no upstream water development had taken place. Estimates of natural flow were based upon streamflow and precipitation records, historical accounts of streamflow, records of irrigated acreage, and empirically-derived estimates of the effects on streamflow of Bluewater Lake, groundwater withdrawals, and irrigation diversions. Natural streamflow in the Rio San Jose at the western boundary of the Pueblo of Acoma is estimated to be between 13,000 and 15,000 acre-feet per year, based on 55 years of recorded and reconstructed streamflow data from water years 1913 to 1972. Natural streamflow at the western boundary of the Pueblo of Laguna is estimated to be between 17,000 and 19,000 acre-feet per year for the same period. The error in these estimates of natural streamflow is difficult to assess accurately, but it probably is less than 25 percent. (USGS)
W84-03560

UNCERTAINTIES IN RECORDS OF ANNUAL MEAN DISCHARGE IN MAINE,
Geological Survey, Augusta, ME. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-03564

USE OF DIGITAL LAND-COVER DATA FROM THE LANDSAT SATELLITE IN ESTIMATING STREAMFLOW CHARACTERISTICS IN THE CUMBERLAND PLATEAU OF TENNESSEE,
Geological Survey, Nashville, TN. Water Resources Div.
E. F. Hollyday, and G. R. Hansen.
USGS Water-Resources Investigations Report 82-4059, 1983. 45 p, 4 Fig, 9 Tab, 17 Ref.

Descriptors: Hydrology, *Remote sensing, *Watersheds (basins), *Hydrologic networks, Satellites, Terrain analysis, Floods, Low flow, *Tennessee, Cumberland Plateau, *Statistical analysis, Computer processing, Multi-spectral image analysis, Multiple linear regression.

Streamflow may be estimated with regression equations that relate streamflow characteristics to characteristics of the drainage basin. A statistical experiment was performed to compare the accuracy of equations using basin characteristics derived from maps and climatological records (control group equations) with the accuracy of equations using basin characteristics derived from Landsat data as well as maps and climatological records (experimental group equations). Results show that when the equations in both groups are arranged into six flow categories, there is no substantial difference in accuracy between control group equations and experimental group equations for this particular site where drainage area accounts for more than 90 percent of the variance in all streamflow characteristics (except low flows and most annual peak logarithms). (USGS)
W84-03566

MAN-INDUCED CHANNEL ADJUSTMENT IN TENNESSEE STREAMS,
Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 4C.
W84-03567

FLOODS IN KANSAS CITY, MISSOURI, AND VICINITY, AUGUST 12-13, 1982,
Geological Survey, Rolla, MO. Water Resources Div.
L. D. Becker, T. W. Alexander, and L. A. Waite.
USGS Water-Resources Investigations Report 83-4141, 1983. 35 p, 13 Fig, 4 Tab, 11 Ref.

Descriptors: *Floods, *Urban runoff, *Flash floods, *Flood peak, Surface runoff, Storm runoff, Runoff volume, Stream gages, Flood recurrence-interval, Surface water, *Missouri, Jackson County, Clay County, Cass County, *Kansas City.

On August 12-13, 1982, a nearly stationary weather front in the vicinity of Kansas City, MO, produced intense thunderstorms. Excessive rainfall (12.6 inches in Raytown, MO) caused flash flooding during the nighttime and early daylight hours. Four deaths and damages unofficially estimated in excess of $30 million, occurred in the three-county area of Jackson, Cass, and Clay counties. Peak discharges were determined at 12 current or discontinued streamflow-gaging stations and 17 miscellaneous sites. Flood peaks and volumes at many locations exceeded estimated 100-year recurrence-interval floods and equaled or exceeded the 1977 floods in some drainage basins. Significant flooding occurred in the Blue, East Fork Little Blue, and Little Blue River basins and in the Rock, Wilkerson, Sni-A-Bar, Shoal, and Big Creek drainage basins. (USGS)
W84-03576

WATER-RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN WYOMING, FISCAL YEARS 1981 AND 1982,
Geological Survey, Cheyenne, WY. Water Resources Div.
USGS Open-File Report 83-254, 1983. 116 p, 11 Fig, 5 Tab. S. L. Green, compiler.

Descriptors: Water resources, *Hydrologic data, *Wyoming, Streamflow, Sediment load, Water quality, Groundwater, Water supply, Environmental effects, Oil shale, Coal regions.

This report contains lists and location maps of streamflow and reservoir stations, peak-flow partial-record stations, water quality stations, sediment stations, and ground-water stations that are currently being operated. Water-resources appraisal projects in Wyoming are also described, including many that are related to development of energy resources. The general locations of the projects are shown on maps. The U.S. Geological Survey is striving to coordinate its water-resources investigations with those of other agencies. This report is one phase of that coordination effort, and serves as an annual progress report to cooperators and the public. (USGS)
W84-03580

CHEMICAL AND HYDROLOGIC ASSESSMENT OF THE CALOOSAHATCHEE RIVER BASIN, LAKE OKEECHOBEE TO FRANKLIN LOCK, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
H. R. La Rose, and B. F. McPherson.
USGS Water-Resources Investigations Report 83-4126, 1983. 63 p, 18 Fig, 15 Tab, 18 Ref.

Descriptors: *Nutrients, Flow, Canals, *Salinity, Algae, *Eutrophication, Caloosahatchee River, Caloosahatchee Canal, *Florida.

Annual discharge (1970-79 water years) from Lake Okeechobee to the Caloosahatchee River averaged 51 percent of the total river discharge at Franklin Lock and ranged from 10 to 71 percent of total discharge. Excluding rainfall on the river surface and upstream seepage, surface and subsurface runoff from the basin accounted for the remaining total river discharge at Franklin Lock. Nitrogen and phosphorus were in sufficient supply most of the time to support algal growth in the river. During algal blooms, however, nitrite plus nitrate nitrogen was depleted and probably became limiting. Nitrite plus nitrate was the predominant form of inorganic nitrogen in the river and in most tributaries. Average concentrations in the river were 0.18 to 0.21 milligram per liter. Average concentrations in most tributaries were less than those in the river. Average concentrations of total phosphorus in many tributaries fell within the same range as that in the river (0.08 to 0.15 milligram per liter), but some tributaries in the eastern part of the basin had greater average concentrations. (USGS)
W84-03591

TIME-OF-TRAVEL AND DISPERSION STUDIES, LEHIGH RIVER, FRANCIS E. WALTER LAKE TO EASTON, PENNSYLVANIA,
Geological Survey, Harrisburg, PA. Water Resources Div.
C. D. Kauffman, Jr.
USGS Open-File Report 82-861, May, 1983. 32 p, 20 Fig, 5 Tab, 4 Ref.

Descriptors: *Tracers, *Dispersion, *Dilution, *Velocity, Streamflow, Time-of-travel, Concentration attenuation, Lehigh River, *Pennsylvania.

Results of time-of-travel and dispersion studies are presented for the 77.0 mile reach of the Lehigh River from Francis E. Walter Lake to Easton, Pennsylvania. Rhodamine WT dye was injected at several points for a variety of several common flow conditions and its downstream travel was monitored at a number of downstream points by means of a fluorometer. Time-of-travel data have been related to stream discharge, distance along the river channel and dispersion. If 2.205 pounds of a conservative water soluble contaminant were accidentally spilled into the Lehigh River at Penn Haven Junction at Black Creek 6.09 miles downstream from Rockport, Pennsylvania, when the discharge at Walnutport, Pennsylvania, was 600 cubic feet per second, the leading edge, peak, and trailing edge of the contaminant would arrive 31.6 miles downstream at the Northhampton, Pennsylvania, water intakes 45, 54, and 66 hours later, respectively. The maximum concentration expected at the intakes would be about 1.450 micrograms per liter. From data and relations presented, time-of-travel and maximum concentration estimates can be made for any two points within the reach. (USGS)
W84-03603

BASE FLOW AND GROUND WATER IN UPPER SWEETWATER VALLEY, TENNESSEE,
Geological Survey, Nashville, TN. Water Resources Div.
R. D. Evaldi, and J. G. Lewis.
USGS Water-Resources Investigations Report 83-4068, 1983. 30 p, 18 Fig, 8 Tab, 14 Ref.

Descriptors: Water resources, *Karst, *Limestone, Solutioning, Solution cavities, Hydrology, Hydrogeology, Carbonate-rock hydrology, Well supplies, *Base flow, *Tennessee, Valley and Ridge Physiographic Province, Monroe County, McMinn County, Loudon County, Sweetwater Valley.

Base flow measurements showed interbasin transfer of water among sub-basins of upper Sweetwater Valley. In general, topographically higher subbasins have deficient surface outflow unless significant spring flow occurs in the basin. Topographically lower areas adjacent to the main channel of Sweetwater Creek generally have surplus flow. Major flow surpluses were associated with areas in which the majority of flow originated at a spring. Unusual outflow was related to geology to hypothesize a ground-water flow network. Areas of ground-water flow up-gradient of large springs were hypothesized as likely areas for significant ground-water reservoirs. A water budget study indicated that during dry years approximately three-fourths of the annual flow to Sweetwater Creek may be derived from ground-water sources. Streamflow records were analyzed to estimate the frequency of low-flow of Sweetwater Creek. (USGS)
W84-03605

UNIFIED NATIONAL PROGRAM FOR FLOOD PLAIN MANAGEMENT.
Water Resources Council, Washington, DC.
For primary bibliographic entry see Field 6F.
W84-03664

TWO APPROACHES FOR ESTIMATION OF MANNING'S N IN MOUNTAIN STREAMS,
Wyoming Water Research Center, Laramie.
T. A. Wesche, W. T. Hill, and V. R. Hasfurther.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84-154400, Price codes: A03 in paper copy, A01 in microfiche. Completion Report, September, 1983. 48 p, 17 Fig, 7 Tab, 14 Ref. Project No. OWRT A-030-WYO (2), Contract/Grant No. 14-34-0001-2154.

Descriptors: Natural streams, *Manning's Equation, *Roughness coefficient, Velocity, *Flow characteristics, Hydraulic models, Rocky Mountain region, Errors, Manning's n, Roughness (hydraulic).

An analysis of roughness coefficients for mountain streams in the Rocky Mountain Region was conducted to devise an empirical method for determination of Manning's n. Two approaches were developed. One procedure utilizes a diagrammatic key approach based upon water surface slope and observable channel characteristics, while the other attempts to relate the time-of-travel velocity of a dye cloud through a stream reach to channel roughness. The conclusions drawn indicate that good potential exists for the use of the diagrammatic key approach. A second significant conclusion of the study is that the estimation of n for steep, rough, tributaries at low flow by means of published tables and/or photographic comparisons can lead to erroneous results.
W84-03666

MAGNITUDE AND FREQUENCY OF FLOODS IN NEW JERSEY WITH EFFECTS OF URBANIZATION,
S. J. Stankowski.
Special Report 38, New Jersey Dept. of Environmental Protection, 1974. 46 p, 15 Fig, 7 Tab, 22 Ref.

Descriptors: *Flood peak, *Model studies, *Flood basins, *Flood recurrence interval, *Flood profiles, *Regional floods, Historic floods, Catchment areas, Maximum probable floods, Flood plain management, Mathematical models, Mathematical analysis, Floods.

This study developed an inexpensive and rapid method for estimating flood-peak magnitudes having recurrence intervals ranging up to 100 years for drainage basins larger than one square mile. The basins had various degrees of urban and suburban development. The method had to be applicable at open-channel sites on any nontidal New Jersey stream where flood flow is not significantly affected by upstream reservoir operation. Mathematical and graphical relations are presented to estimate flood-peak magnitudes; four parameters are required to use these relations. Three of these may be measured from topographic maps, i.e., basin size, channel slope, and surface storage within the basin. The fourth is an index of man-made impervious cover which can be determined for existing and future development conditions from census data and from readily available population projections. Developed from an analysis of flood information for 103 sites in New Jersey (the average period of record for the stations was 27 years), the relations should be useful for design of bridge waterway openings, selection of optimum size for drainage structures, evaluation of flood hazards for alternative land-use plans, and for definition of floodway and flood-hazard-area limits. Statewide averages indicate that urban and suburban development increases flood peaks up to three times at the 2-year recurrence interval and up to 1.8 times at the 100-year recurrence interval. (Garrison-Omniplan)
W84-03684

FLOODS OF AUGUST AND SEPTEMBER 1971 IN NEW JERSEY,
S. J. Stankowski.
Special Report, New Jersey Dept. of Environmental Protection, 1972. 204 p, 77 Fig, 9 Tab, 11 Ref, 1 Append.

Descriptors: *Historic floods, *Flash floods, *Storm water, *Rainstorms, *Precipitation, *Rainfall impact, Flood-plain management, Rainfall, Gaging stations, Flood peak, Rivers, Bridge design.

Floods of unprecedented magnitude in August 1971 created havoc in south-central, central and northeastern New Jersey. Then, record-breaking floods in September 1971 occurred in the highly urbanized basins of northeastern New Jersey. Total storm rainfall amounts in August during a 32-hour period ranged from about 3 to over 11 inches across New Jersey. River levels reached stages greater than any previously known in many areas of the state. The September flood averaged about 7 inches in northeastern New Jersey and caused recordbreaking peak flows in many streams. Detailed hydrologic data are provided on precipitation, stage and discharge for each gaging station during the period of storm runoff, flood stages and discharges, a comparison with the maximum floods previously known, and the estimated recurrence level. Flood-crest elevations are tabulated for more than 700 sites, in addition to the gaging stations. Flood profiles are shown for 36 streams. The stations at which new peak discharges were recorded had periods of record, in 1971, ranging from 1 to 51 years. New peak discharges were established at 17 stream-gaging stations with more than 30 years of record. The data presented may be used for planning and designing hydraulic structures and flood-protection works, for bridge and culvert design, for flood-plain management and flood insurance purposes, and for water-supply volume studies. (Garrison-Omniplan)
W84-03685

TECHNICAL MANUAL FOR ESTIMATING LOW-FLOW CHARACTERISTICS OF PENNSYLVANIA STREAMS,
Geological Survey, Harrisburg, PA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-03688

HINDCASTING MONTHLY RUNOFF,
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
E. F. Brater, and R. Wallace.
Journal of Hydraulic Engineering, Vol. 110, No. 2, p 126-141, February, 1984. 7 Fig, 2 Tab, 9 Ref, 1 Append.

Descriptors: *Hindcasting, *Runoff, *Precipitation rate, Temperature, Rainfall-runoff relationships, Gaging, Hydrologic budget, History, Water loss, Water storage.

Research was carried out to develop relatively simple low cost procedures for estimating chronological monthly runoff for the historical period before a gaging station was installed on the river but during which precipitation and temperature records are available. The method also supplies estimates of runoff during periods of missing records. The procedures are based on the equation for the water budget of a drainage basin which shows runoff to be a function of precipitation, water losses, and the change in storage. It is shown that current and antecedent precipitation and temperature can be used as independant variables to account for the water loss and storage terms. The methods were tested by calibrating the models for the more recent years of records and then hindcasting runoff for earlier periods during which measured runoff was available for comparison. (Author's abstract)
W84-03718

MEASUREMENT OF STREAMWISE VORTICITY FLUCTUATIONS IN A TURBULENT CHANNEL FLOW,
Max-Planck-Inst. fuer Stroemungsforschung, Goettingen (Germany, F.R.).
E. G. Kastrinakis, and H. Eckelmann.
Journal of Fluid Mechanics, Vol. 137, p 165-186, December, 1983. 23 Fig, 37 Ref.

Descriptors: *Channel flow, *Turbulent flow, Measuring instruments, Vorticity, Flow, Velocity, Streams.

Measurements of streamwise vorticity fluctuations have been made in a fully developed turbulent channel flow. A newly designed probe provided simultaneously in addition to the vorticity signal all three velocity signals. The new probe resembles the Kovasznay-type vorticity probe, but consists of four electrically independent hot wires, each mounted separately on a total of eight supporting prongs. A new calibration technique had to be developed for this probe. A strong increase of flatness factor with wall distance indicates a strongly intermittent character for the streamwise component of vorticity in this region. The flatness factor shows values similar to those for the three fluctuating velocity components only in the vicinity of the wall, where most streamwise vortices are observed. (Baker-IVI)
W84-03772

NEW NON-LINEAR CONCEPTUAL MODEL OF FLOOD WAVES,
Polish Academy of Sciences, Warsaw. Inst. of Geophysics.
J. J. Napiorkowski, and P. O'Kane.
Journal of Hydrology, Vol. 69, No. 1, p 43-58, February, 1984. 5 Fig, 13 Ref.

Descriptors: *Flood waves, *Model studies, St. Venant's model, Open channels, Hydrologic models, Simulation.

St. Venant's nonlinear distributed model of flood waves in open channels has been successfully simulated using a much simpler nonlinear lumped conceptual model. This simpler model is composed of a cascade of equal nonlinear storage elements preceded by an element of pure delay. The linear channel (a pure translatory system) reflects the time of propagation of a perturbation along the positive characteristic. The cascade of nonlinear reservoirs is responsible for the attenuation of the system response. The simpler model depends on four parameters only. The first two terms of the Taylor expansion of the state trajectory are shown to be equivalent to the first two terms of a Volterra convolution series. An example is offered to demonstrate the accuracy of this quadratic approximation. (Baker-IVI)
W84-03776

FLOOD ROUTING BY A LINEAR SYSTEMS ANALYSIS TECHNIQUE,
Ministry of Works and Development, Christchurch (New Zealand).
D. G. Goring.
Journal of Hydrology, Vol. 69, No. 1, p 59-76, February, 1984. 7 Fig, 4 Tab, 11 Ref.

Descriptors: *Flood routing, *Model studies, Linear programming, Systems analysis, Hydrologic models, River systems, Estimating, Forecasting.

There are two modes of flood routing: simulation and forecasting. A hydrological technique for flood routing using linear systems analysis has been presented and applied to a practical case both in the simulation and the forecasting mode. This method has particular application in river systems where the contribution from ungauged tributaries is significant. The method gives the peak flow within 12% accuracy in both modes in an example where only 57% of the total flow into the system was available for analysis. From a hydraulician's point of view, the main problem with a linear model for routing floods is that it may underestimate the wave speed. However, the linear systems method allows for this and the time of the flood peak usually is estimated within one time unit on either side of the actual time. (Baker-IVI)
W84-03777

TESTING PHYSICALLY-BASED FLOOD FORECASTING MODEL (TOPMODEL) FOR THREE U.K. CATCHMENTS,
Institute of Hydrology, Wallingford (England).
K. J. Beven, M. J. Kirkby, N. Schofield, and A. F. Tagg.
Journal of Hydrology, Vol. 69, No. 1-4, p 119-143, February, 1984. 13 Fig, 4 Tab, 23 Ref. N.E.R.C. grant GR3/2119.

Descriptors: *Flood forecasting, *Model studies, *Catchment areas, Crimple Beck, Hodge Beck, Wye headwater, Wales, Rainfall-runoff relationships, Rainfall, Evaporation, TOPMODEL, Model testing.

For many years, attempts at modelling the complex processes by which a basin converts rainfall to runoff were largely concerned with using lumped analogues. More recently, attention has concentrated on the 'contributing area' concept, so that is now accepted that the dynamic spatial variability of these runoff source areas must be treated more effectively. A previously developed model has been tested on three catchments: Crimple Beck (8 sq km) near Harrogate, Hodge Beck (36 sq km) on the North York Moors and the Wye headwater (10.5 sq km) in central Wales. The model was originally validated on subcatchments within Crimple Beck. For this study forecasts were made over a period of one year, based only on rainfall and evaporation data. The model parameters were derived from a defined program of field measurements over a period of 2-4 weeks, and no formal optimization procedures were carried out before comparing forecasts with the measured stream discharge record. As a result of the comparisons, the model is seen as a useful approach for ungauged catchments of up to 500 sq km in humid-temperature climates. (Murphy-IVI)
W84-03779

METHOD FOR THE DETERMINATION OF THE DISCHARGE-FREQUENCY RELATIONSHIP IN UNGAGED ARID GRAVEL STREAMS,
Geological Survey of Israel, Jerusalem.
A. B. Begin, and M. Inbar.
Journal of Hydrology, Vol. 69, No. 1-4, p 163-172, February, 1984. 5 Fig, 1 Tab, 6 Ref.

Descriptors: *Flows, *Model studies, *Stream discharge, Drainage basins, Stream beds, Negev, Israel, Arid regions, Geomorphology.

Significant statistical relationships were defined between shear stress exerted by flows of certain recurrence intervals on stream beds and grain-size distribution. Based on these relationships it is proposed to determine discharge-frequency curves in ungaged reaches of the arid Negev of Israel. Application of this method requires measurement of the hydraulic geometry of the desired reach and the grain size of some samples in it. The method was applied to the lower reach of Nahla Zin and the 50-and 100-yr peak discharges were estimated. The results agreed with an estimate based on an assessment of discharge per unit area in the same drainage basin. (Baker-IVI)
W84-03781

STOCHASTIC ANALYSIS OF HIGH FLOWS GENERATED BY MIXED PROCESSES,
Saskatchewan Univ., Saskatoon. Dept. of Geography.
P. R. Waylen, and M.-K. Woo.
Canadian Journal of Civil Engineering, Vol. 10, No. 4, p 639-648, December, 1983. 6 Fig, 4 Tab, 6 Ref.

Descriptors: *Stochastic hydrology, *High flows, *Flood flow, Model studies, Probabilistic process, Mathematical studies, Snowmelt, Rainfall, Floods, Prediction, British Columbia.

Concepts previously developed and tested to analyze floods generated by a single process have been extended so as to be applicable to high flows resulting from more than one hydrological process. The method described preserves a theoretical and physical basis. A subdivision of the nonhomogeneous high flow data on the grounds of clearly definable hydrological processes also tends to improve the prediction of flood probabilities. The procedures are easy to apply and investigation of flood characteristics at increasingly higher truncation levels supports the finding that a complete reanalysis of data is not necessary, thus simplifying the computational task when information pertaining to various flood levels is required. The methodology is applied to three basins in southwestern British Columbia that experience both snowmelt and rainfall generated floods. (Baker-IVI)
W84-03799

ROLE OF CURRENT VELOCITY IN STRUCTURING EELGRASS (ZOSTERA MARINA L.) MEADOWS,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
M. S. Fonseca, J. C. Zieman, G. W. Thayer, and J. S. Fisher.
Estuarine, Coastal and Shelf Science, Vol. 17, No. 4, p 367-380, October, 1983. 5 Fig, 3 Tab, 27 Ref. NSF, International Decade of Ocean Exploration, Seagrass Ecosystem Study grant OCE77-27051.

Descriptors: *Water currents, *Velocity, *Eelgrass, Sediment distribution, Equilibrium, Habitats.

Measurements of velocity profiles, bathymetry, and surface sediment characteristics across eelgrass (Zostera marina L.) meadows yielded information on community development processes and functional attributes of this ecosytem. Height/length ratios of the meadows were positively correlated with tidal current velocity. Low, medium, and high current regimes were separated by surface current velocities of approximately 50 and 90 cm/s. Z. marina can tolerate approximately 120-150 cm/sec current velocities in the areas studied. Per cent silt-clay and organic matter content of the surface sediments are negatively associated with shead velocity, suggesting that meadows in high current areas are sources while meadows in low current areas are sinks of autochthonous detritus. Current velocity maintains seagrass meadows at different equilibrium levels (relative climaxes). We theorize these different equilibrium levels provide unequal habitat utilization potentials for the associated faunal community. (Author's abstract)
W84-03803

MODELING RAPIDLY VARIED FLOW IN TAILWATERS,
Army Command and General Staff Coll., Fort Leavenworth, KS.
M. G. Ferrick, J. Bilmes, and S. E. Long.
Water Resources Research, Vol. 20, No. 2, p 271-289, February, 1984. 20 Fig, 19 Ref.

Descriptors: *Hydrologic models, *Tailwater, *Varied flow, Waves, Hydroelectric power, Physical properties, Mathematical models, Flow regimes.

An understanding of the downstream propagation of sharp-fronted, large-amplitude waves of relatively short period is important for describing rapidly varying flows in tailwaters of hydroelectric plants and following the breach of a dam. A numerical model of these waves was developed by first identifying the primary physical processes and then performing an analysis of the solution. A linear analysis of the dynamic open channel flow equations provides relationships describing flow wave advection, diffusion, and dispersion in rivers. A one-dimensional diffusion wave model modified for application to tailwaters simulates the important physical processes and is straightforward to apply. The 'modified equation' and von Neumann analyses provide insight into the effects of numerical parameters theta, delta x, and delta t upon stability and dissipative and dispersive behavior of the solution, but the Hirt analysis is found to yield incorrect phase relationships. The capability and accuracy of the model are enchanced when physical diffusion of a river wave is balanced by numerical diffusion in the model. Field studies were conducted in two greatly different tailwaters to assess our understanding of large-scale, rapidly varying flow waves. The accurate simulation of waves having wide-ranging amplitudes, shapes, periods, and base flows attests to the soundness of both the physical basis of the model and the numerical solution technique. These studies reveal that diffusion of short-period waves in natural, free-flowing rivers is signficiant and that inertia is negligible. (Murphy-IVI)
W84-03824

FLOOD ESTIMATES FOR UNGAGED STREAMS IN GLACIER AND YELLOWSTONE NATIONAL PARKS, MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
R. J. Omang, C. Parrett, and J. A. Hull.
USGS Water-Resources Investigations Report 83-4147, July, 198. 10 p, 2 Fig, 2 Tab, 4 Ref.

Descriptors: Water rights, Regression analysis, Estimating equations, Streamflow, Drainage area, Glacier National Park, Yellowstone National Park, Basin characteristics, *Montana.

Estimates of 100-year discharges were made at 59 sites in Glacier National Park and 21 sites in Yellowstone National Park to assist the National Park Services in quantifying stream inflow and outflow in the Parks. The estimates were made using regression equations previously developed for Montana. The resulting 100-year discharges are listed in tables; the discharges ranged from 260 to 53,200 cu ft/s in Glacier National Park and from 110 to 27,900 cu ft/s in Yellowstone National Park. (USGS)
W84-03849

FLOOD OF JUNE 15, 1981, IN GREAT BEND AND VICINITY, CENTRAL KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
R. W. Clement, and D. G. Johnson.
Available from the Ofss, USGS, Lakewood, CO 80225, Price: $1.50 in paper copy, $3.50 in microfiche. USGS Water-Resources Investigations Report 82-4123, 1982. 9 p, 2 Fig, 2 Tab, 1 Ref.

Descriptors: *Floods, Flood frequency, Precipitation excess, Flood damage, Indirect flood measurement, Great Bend, *Kansas.

Torrential precipitation, as much as 20 inches in 12 hours, resulted in unprecedented flooding on Dry Walnut Creek in southwestern Barton County, central Kansas. Runoff from the storm caused extensive flooding in the town of Great Bend on June 15, 1981. Estimates of total damages exceeded $42 million. Measurements of peak discharges made in the downstream part of the Dry Walnut Creek watershed were as much as 3 1/2 times the estimated magnitude of the 100-year flood and in some locations exceeded the maximum previously measured discharge for the area. (USGS)
W84-03855

MUDFLOW HAZARDS ALONG THE TOUTLE AND COWLITZ RIVERS FROM A HYPOTHETICAL FAILURE OF SPIRIT LAKE BLOCKAGE,
Geological Survey, Tacoma, WA. Water Resources Div.
C. H. Swift, III, and D. L. Kresch.
Available from the Ofss, USGS, Lakewood, CO 80225, Price: $19.75 in paper copy, $3.50 in microfiche. USGS Water-Resources Investigations Report 82-4125, 1983. 20 p, 15 Fig, 2 Ref.

Descriptors: *Mudflows, Dam failure, *Flood inundation maps, *Washington State, Spirit Lake, *Mount St. Helens, Toutle River, Cowlitz River.

The debris avalanche accompanying the May 18, 1980, eruption of Mount St. Helens, in southwestern Washington, buried the former outlet of Spirit Lake, located 5 miles north of the volcano, to a depth ranging to 500 feet. Since that time, Spirit Lake has had no natural outlet and its lake level and contents have increased significantly. Erosion at the crest of the debris dam on the surface of the blockage and recent studies of the blockage stratig-

raphy and soil properties showing that the effective crest elevation is lower than the surface crest have led to concern that the lake may someday breach through or spill over the top of the blockage. A study was made by the U.S. Geological Survey to determine the extent of inundation that might result downstream in the Toutle and Cowlitz Rivers if a hypothetical breach should occur and generate a mudflow flood of catastrophic proportions. A hypothetical breach of Spirit Lake produced a hypothetical mudflow hydrograph with a peak discharge of 2.65 million cu ft/s and a sediment concentration of 65 percent by volume at Camp Baker on the North Fork Toutle River. Elevations determined by the hydraulic routing of the mudflow were used to prepare inundation maps, indicating depths of inundation to be about 60 feet at Castle Rock and Lexington; 30-40 feet at Toutle, Toutle Lake at Silver Lake, Kelson, and Longview; and 15-20 feet at Toledo. Travel times for the peak elevation were estimated to be about 15 hours to Kid Valley on the North Fork Toutle River, 21 hours to Castle Rock, 22 hours to Toledo, and 23 hours to Kelso and Longview on the Cowlitz River. (USGS)
W84-03856

INSTABILITY OF HYPERCONCENTRATED FLOW,
Technical Univ. of Denmark, Lyngby. Inst. of Hydrodynamics and Hydraulic Engineering.
F. Engelund, and W. Zhaohui.
Journal of Hydraulic Engineering, Vol. 110, No. 3, p 219-233, March, 1984. 13 Fig, 1 Tab, 5 Ref.

Descriptors: *Hyperconcentrated flow, *Flow characteristics, Flow, Flow profiles, Hydrodynamics, Mathematical models, Flood control, Flood plain management, River flow, Yellow River, China.

Volume concentrations of sediment as high as 35% have been recorded in the Yellow River and 56% in its tributaries. Such hyperconcentrated flow behaves quite differently from ordinary sediment-laden flow. The instability of hyperconcentrated flow observed in nature is reproducible in laboratory flumes using suspensions of bentonite. Similar instabilities are observed in a much simpler hydraulic system consisting of a container feeding a closed conduit. The behavior of two different clay suspensions, kaoline and bentonite, was investigated and the rheological properties were measured in a rotating viscosimeter. These non-Newtonian fluids are close to Bingham fluids, but deviate for small deformation rates. The instability is associated with some specific rheological properties. A simple mathematical model explains why the bentonite suspension was unstable at small discharges and stable at sufficiently large discharges. The kaoline suspensions were always stable. The agreement between calculations and observations is encouraging. (Murphy-IVI)
W84-03917

SYNTHETIC STREAMFLOW FORECAST GENERATION,
Washington Univ., Seattle. Dept. of Civil Engineering.
D. P. Lettenmaier.
Journal of Hydraulic Engineering, Vol. 110, No. 3, p 277-289, March, 1984. 4 Fig, 14 Ref. OWRT grant B-080-WASH.

Descriptors: *Streamflow forecasting, Mathematical models, Simulation analysis, Optimum development plan, Algorithms, Skykomish River, Washington.

Simulation models have proven a durable and useful tool for the development of water resource system operating policies. One important component of any operating policy is streamflow forecasting. Incorporation of streamflow forecasts in a simulation model can be difficult because of the stochastic nature of forecasts and the range of forecast models in use. A forecast generation algorithm is developed which is applicable for any forecast model, and requires as input only the coefficient of prediction, a measure of forecast accuracy, and the first three moments of the forecast period flows. The algorithm uses a lag one Markov structure for forecast errors, where the correlation coefficient is a function of the forecast model coefficient of prediction. The generation algorithm is demonstrated for simulation of 7 and 120 day forecasts for the Skykomish River, Washington. (Author's abstract)
W84-03920

CYANAZINE LOSSES IN RUNOFF FROM NO-TILLAGE CORN IN 'LIVING' AND DEAD MULCHES VS. UNMULCHED, CONVENTIONAL TILLAGE,
Pennsylvania State Univ., University Park.
J. K. Hall, N. L. Hartwig, and L. D. Hoffman.
Journal of Environmental Quality, Vol. 13, No. 1, p 105-110, 1984. 8 Tab, 15 Ref.

Descriptors: *Cyanazine, *Agricultural runoff, *No-tillage, *Corn, Mulch, Tillage, Herbicides, Water pollution sources, Pennsylvania.

In recent years, significant increases in planting of no-tillage corn has stirred our interest in determining the impact of this tillage system and residue mulched soil surfaces in reducing both erosion and herbicide losses from sloping cropland. Reduction of herbicide losses is important, due to frequently increased use of herbicides in this type of land culture. Moreover, occasional reports claiming increased chloro-s-triazine herbicide contamination of surface waters from agricultural, nonpoint source pollution, targeted as excessive runoff from conventional- and even reduced-tillage-planted corn land, despite considerable data to the contrary, provided the impetus for further research in this area. Losses of cyanazine in runoff from untilled soil planted to corn (Zea mays L.) were compared with losses from conventionally planted corn on a 14% slope in the growing seasons of 1977 through 1979. The no-tillage systems consisted of corn planted into corn stover residue and into 'living mulches' of birdsfoot trefoil (Lotus corniculatus) and crownvetch (Coronilla varia L.). The no-tillage systems reduced runoff, erosion, and herbicide movement. For example, runoff from conventional tillage ranged from 5.5 to 22% of the runoff-producing rainfall. Soil loss from the same system ranged from 4.4 to 32.2 Mg/ha. On the other hand, runoff from the no-tillage systems ranged from 0.07 to 2.5% of the runoff-producing rainfall, while soil losses ranged from 0 to 1.1 Mg/ha. Transport of cyanazine in water runoff and entrained sediment from tilled areas totaled 257.0, 16.0, and 32.7 g/ha for the respective growing seasons, which represented 5.71, 0.73, and 1.48% of the amount applied yearly, 4.5 kg active ingredient (ai)/ha-1977; 2.2 kg ai/ha-1978, 1979. In the same years, cyanazine losses from no-tillage areas were 6.5-33.7 g/ha, 0.1-1.8 g/ha, and 1.6-3.3 g/ha at similarly applied rates. Collectively, these represented losses ranging from < 0.01 to 0.75% of sprayed levels. Using conventional tillage as a reference treatment, untilled surfaces reduced runoff from 86.3 to 98.7%, soil losses from 96.7 to 100%, and cyanazine losses from 84.9 to 99.4% over the three growing seasons. In general, the 'living mulch' surfaces were more effective in retarding erosion than the corn stover residue surfaces. Corn grain yields were not significantly reduced by 'living mulches' when adequate legume suppression was obtained with herbicide treatments. (Murphy-IVI)
W84-03941

LONGITUDINAL DISPERSION IN A STREAM CALCULATED BY ONE DIMENSIONAL NUMERICAL MODEL,
Norsk Inst. for Vannforskning, Oslo.
T. Tjomsland.
Nordic Hydrology, Vol. 14, No. 1, p 41-46, 1983. 1 Fig, 1 Tab, 8 Ref.

Descriptors: *Stream flow, *Model studies, *Lena River, *Norway, Flow, Tracers, Solute transport, Path of pollutants.

Longitudinal dispersion is an important process relevant to pollution in natural water courses. In order to control contamination and predict levels of pollution in a strem the stream's capacity to transport and disperse must be known. A one-dimensional numerical model was used to simulate water stage and dispersion of matter in a 2-km reach of the river Lena, southeastern Norway. The mean gradient of the stream was about 1%. The bottom sediments consisted mainly of cobbles and gravel. The transport of the tracer was measured at four stations placed 0.3, 0.5, 1.2, and 2.5 km downstream from the injection point. Calculated results show quite good agreement with field measurements. (Baker-IVI)
W84-03975

DEVELOPMENT AND APPLICATION OF A STORAGE MODEL FOR RIVER FLOW FORECASTING,
Kobe Univ. (Japan). Dept. of Agricultural Engineering.
T. Hata, and M. G. Anderson.
Nordic Hydrology, Vol. 14, No. 3, p 139-154, 1983. 12 Fig, 1 Tab, 5 Ref.

Descriptors: *Model studies, *Rainfall-runoff relationships, Floods, Prediction, Flood control, River flow, River Avon, England, River Kako, Japan.

A lumped sequential river flow forecasting model was developed which is flexible in both temporal and spatial scales, thus allowing simulations to be undertaken for a wide range of practical purposes. The method has some advantages compared with the discrete runoff analysis or direct runoff analysis method. One such advantage is the direct information about the storage of water in a river basin just before a storm which has a big influence on a flood runoff. The change from long-term simulation to short-term simulation and vice versa is easy in the current procedure because of the use of the same model with the same parameters. The required data input is very low and is restricted to topographic data for only small segments of the entire catchment. The model is successfully applied to the River Avon in England and the River Kako in Japan. (Baker-IVI)
W84-03983

FURROW IRRIGATION RUNOFF: A LINEAR SYSTEMS APPROACH,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
S. Sritharan, W. Clyma, and E. V. Richardson.
Journal of Irrigation and Drainage Engineering, Vol. 109, No. 1, p 29-42, March, 1983. 11 Fig, 6 Tab, 13 Ref, 3 Append.

Descriptors: *Furrow irrigation, *Runoff, Flood routing, Routing, Model studies, Unit hydrographs, Uniformity coefficient, Input-output analysis.

Runoff models for freely draining surface irrigation systems are mainly useful for the design of reuse systems and surface drainage systems. When a linear flood routing approach is taken for furrow irrigation runoff, the problem of delay in system response is confronted. This was dealt with by a constant response-variable delay linear model, and the corresponding input-output relationship was derived. This relationship of Duhamel Integral type was discretized, and an unconstrained least squares minimization procedure was used for the system identification for a set of furrow irrigation field data. After identifying a suitable delay function, the developed unit hydrographs were used in the interfurrow and interirrigation modes. Surface effects produced by clods and other nonuniformities existing in the furrows can cause considerable variation in the runoff prediction from the measured value. Uniformity in surface conditions is necessary for the successful application of the unit runoff hydrograph concept to furrow runoff prediction. (Murphy-IVI)
W84-04036

CENTRAL KANSAS FLASH FLOODS OF JUNE 1981,
National Weather Service Forecast Office, Topeka, KS.
L. W. Schultz.

Bulletin of the American Meterological Society, Vol. 65, No. 3, p 228-234, March, 1984. 5 Fig, 2 Ref.

Descriptors: *Flash floods, *Storms, *Kansas, *Flood forecasting, Great Bend, Hoisington, Soil water, Forecasting.

Two severe flash floods in central Kansas during June of 1981 were unusual as they occurred close together in time and space, only 8 days and 16 km apart. Terrain was not an important contributing factor to either flood. Moist soil that resulted from the first storm was apparently a significant contributor to the second flood. Forecasters should be alert to antecedent soil conditions. The maximum rainfall during the Hoisington storm washout was 185 mm which under normal circumstances would not have caused flooding. However, 100-150 mm of precipitation had fallen during the Great Bend storm only 8 days earlier. When moist soil conditions exist, considerably less rainfall is needed to produce flash flooding. The first, the Great Bend storm, developed during the afternoon and continued into the night, suggesting that daytime heating played a key role in initiating the convection. The Hoisington storm was a nocturnal event and occurred in the cooler air north of a stationary front with convection resulting from the flow of moist unstable air over the frontal zone. The moisture content of the atmosphere was very high for each event. The Great Bend and Hoisington storms had the general characteristics of the synoptic and frontal type floods, respectively. (Baker-IVI)
W84-04064

MAGNITUDE AND MODELLING OF SNOW-MELT RUNOFF IN THE CAIRNGORM MOUNTAINS, SCOTLAND,

Stirling Univ. (Scotland). Dept. of Environmental Science.
R. I. Ferguson.

Hydrological Sciences Journal, Vol. 29, No. 1, p 49-62, 1984. 6 Fig, 3 Tab, 14 Ref.

Descriptors: *Snowmelt, *Runoff, *Scotland, *Cairngorm Mountains, *River Feshie, Model studies, Streamflow, Seasonal variations, Precipitation, Snowpack.

The Feshie is a right-bank tributary of the Spey draining the western edge of the Cairngorm mountains in Scotland. Streamflow in the River Feshie (106 sq km) shows persistent diurnal oscillations from March to June. Runoff in the study area is dominated by snowmelt in the spring months, with persistent diurnal oscillations reaching on one occasion >40 mm/d of meltwater production averaged over the snow or 23 mm/d over a 106-sq km basin. Daily discharges during the melt season can successfully be simulated from crude meteorological data by a simple lumped temperature-index method with built-in snowpack depletion. The three hydrometeorological parameters appear adequately stable from one year to the next and the model is less sensitive to these than to initial snowpack extent and water-equivalent thickness, which may vary greatly from year to year, and to errors caused by inadequate precipitation data. (Baker-IVI)
W84-04069

REGIONAL RELATIONSHIPS BETWEEN BASIN SIZE AND RUNOFF CHARACTERISTICS,

Athens Univ. (Greece). Dept. of Civil Engineering.
M. Mimikou.

Hydrological Sciences Journal, Vol. 29, No. 1, p 63-73, 1984. 3 Fig, 2 Tab, 15 Ref.

Descriptors: *Runoff, *Drainage basins, Watersheds, Rainfall-runoff relationships, Model studies, Flood control, Storms, Greece.

The maximum observed flood flow, the maximum annual constant loss, the lag time and the unitgraph peak for a certain storm duration for basins in the western and northwestern regions of Greece are increasing power functions of basin size. These functions explain the variation in the analyzed runoff characteristics. The maximum observed floodflow, the maximum annual constant loss, the lag time and the unitgraph peak for a certain storm duration for these basins are increasing power functions of basin size. For both regions single relationships are derived for the lag time and the unitgraph peak, whereas for the observed floodflow and the maximum annual constant loss they vary regionally with the climatic conditions. Care is needed in transferring regional relationships, like the ones in this study outside the immediate range and location of their derivation as they may be regionally varying. The transferability of their parameter values is also doubtful. The derived regional relationships can be used in accurately predicting design flood flows, annual runoff yields and unitgraphs of various storm durations for ungauged basins in the regions studied, needed for the hydrological design of various water resources development systems. (Baker-IVI)
W84-04070

AREAL PREDICTION OF ANNUAL FLOODS GENERATED BY TWO DISTINCT PROCESSES,

McMaster Univ., Hamilton (Ontario). Dept. of Geography.
M.-K. Woo, and P. R. Waylen.

Hydrological Sciences Journal, Vol. 29, No. 1, p 75-88, 1984. 7 Fig, 2 Tab, 8 Ref.

Descriptors: *Floods, *Prediction, Flood frequency, Gumbel distribution, Drainage basins, Mathematical equations, Snowmelt, Rainfall.

The compounded Gumbel distribution provides a good description of flood frequency in areas where the annual peak flows are produced by both snowmelt and rainfall. The spatial variation of the flood generating processes can be represented by trend surfaces fitted to the compounded Gumbel parameters. A combination of the spatial interpolation of the parameter values from the trend surface equations and an expansion of a given equation provides a tool to establish the various probabilities of annual floods for ungauged basins. Two tests were performed to demonstrate the usefulness of the proposed technique. The compounded distribution can apply not only to snowmelt and rainfall induced annual floods, but equally well to handle situations where floods are attributable to distinctive types of rainstorms, such as frontal rain and thunderstorm showers. Where the spatial variation of the distribution parameters is statistically summarized by trend surfaces, the probability distribution of annual floods can be predicted for ungauged streams. Thus the proposed method is applicable to different climatic regions and is practical for deriving flood frequencies for poorly gauged or ungauged basins in many isolated areas of the world. (Baker-IVI)
W84-04071

SPATIAL VARIABILITY OF RUNOFF,

Agricultural Research Service, Columbia, MO. North Central Watershed Research Center.
A. T. Hjelmfelt, Jr., and R. E. Burwell.

Journal of Irrigation and Drainage Engineering, Vol. 110, No. 1, p 46-54, March, 1984. 6 Fig, 2 Tab, 10 Ref.

Descriptors: *Runoff, *Spatial variability, *Small watersheds, Simulation, Water retention, Model studies, Storm runoff, Variability, Confidence limits.

During the spring and summer of 1981, 40 adjacent runoff-erosion plots (each 27.4 x 3.2 m) were maintained in a fallow condition. Twenty-six rainfall events occurred that produced runoff during this period. The array of plots simulate an intensively sampled watershed of field size, so the results are analyzed to describe spatial variation of runoff and water retention. The coefficient of variation for individual events in which all plots exhibited runoff ranged from 0.65-0.07. Individual plots did not react consistently throughout the series of storms, but were seen to shift between producing more and less than the average volume of runoff. In the usual descriptions applied by current mathematical models of small watersheds, each plot was identical, so these results contribute to defining confidence limits that can be applied to model results, i.e., if a mathematical model were constructed that predicted the 40-plot mean for each event, and that model were compared with the observed values for any one plot, there would be differences between predicted and observed results. This study helps to establish the significance of that difference. (Moore-IVI)
W84-04093

PREDICTION OF PEAK FLOWS ON SMALL WATERSHEDS IN OREGON FOR USE IN CULVERT DESIGN,

Pacific Northwest Forest and Range Experiment Station, Juneau, AK. Forestry Sciences Lab.
A. J. Campbell, and R. C. Sidle.

Water Resources Bulletin, Vol. 20, No. 1, p 9-14, February, 1984. 1 Fig, 3 Tab, 16 Ref.

Descriptors: *Flood peak, *Small watersheds, *Culverts, *Oregon, Roads, Forests, Flood frequency, Design criteria, Catchment areas, Precipitation, Elevation.

Using data from 80 Oregon watersheds that ranged in size from 0.54 sq km to 27.45 sq km, equations were developed to predict peak flows for use in culvert design on forest roads. Oregon was divided into six physiographic regions based on previous studies of flood frequency. In each region, data on annual peak flow from gaging stations with more than 20 years of record were analyzed using four flood frequency distributions: type 1 extremal, two parameter-log normal, three parameter-log normal, and log-Pearson type III. The log-Pearson type III distribution was found to be suitable for use in all regions of the State, based on the chi-square goodness-of-fit-test. Flood magnitudes having recurrence intervals of 10, 25, 50, and 100 years were related to physical and climatic characteristics of drainage basins by multiple regression. Drainage basin size was the most important variable in explaining the variation of flood peaks in all regions. Mean basin elevation and mean annual precipitation were also significantly related to flood peaks in two regions of western Oregon. The standard error of the estimate for the regression relationships ranged from 26 to 84%. (Author's abstract)
W84-04098

EFFECTS OF A MOVING RAINSTORM ON DIRECT RUNOFF PROPERTIES,

Department of Agriculture, Lethbridge (alberta). Research Station.
N. Foroud, R. S. Broughton, and G. L. Austin.

Water Resources Bulletin, Vol. 20, No. 1, p 87-91, February, 1984. 5 Fig, 1 Tab, 7 Ref.

Descriptors: *Rainfall-runoff relationships, *Flood flow, *Rainstorms, Flood hydrographs, Simulation, Mathematical models, Flood peak, Velocity, Moving rainstorms, Channel velocity.

The effects of a moving rainstorm on flood runoff characteristics were investigated. A flood hydrograph simulation model called 'FH-Model' and a natural watershed were used. A hypothetical rainstorm of 50 years recurrence interval, 75 mm depth, and 4 hours duration was used to show the effects of velocity and direction of the moving rainstorm on the runoff characteristics. Compared with an equivalent stationary rainstorm (ESRS), the peak flow caused by a rainstorm moving in a downstream direction with a speed equal to channel velocity, V, was 27.5% higher and the peak flow caused by the same rainstorm moving in an upstream direction was 21.7% smaller. These percentages reduced to 10.5% and 8.6% for storms moving downstream and upstream, respectively, at three times the channel velocity, 3V. There were negligible differences in the time of peak, Tp, between runoff caused by storms moving downstream and runoff produced by ESRS. However, Tp for a storm moving upstream at V velocity was 82% higher than that produced by ESRS, but was reduced to 27% higher when the storm velocity was 3V. (Author's abstract)
W84-04108

UNIVARIATE LEAST SQUARES MUSKINGUM FLOOD ROUTING,
New Mexico Univ., Albuquerque. Dept. of Civil Engineering.
R. J. Heggen.
Water Resources Bulletin, Vol. 20, No. 1, p 103-107, February, 1984. 1 Fig, 1 Tab, 17 Ref.

Descriptors: *Flood routing, *Muskingum method, Hydrologic models, Univariate least squares method, Univariate transformation.

The Muskingum method of hydrologic flood routing is based on a graphical bivariate curve fitting procedure. The subjectivity of this procedure may lead to problems of reproducibility and provides no guarantee of model coefficients which minimize the error of estimation. A transformation is developed to express the Muskingum method as a univariate transcendental function suitable for numeric solution. Solution of this function minimizes the sum of the squared deviations between estimated and measured rates of discharge. Five textbook examples of the Muskingum method are evaluated by the univariate transformation. Error reductions range from negligible to tenfold. While the univariate transformation may not improve upon graphically-based results in every case, in no instances are the univariate results inferior; in many cases they are superior. (Author's abstract)
W84-04110

WESTERN WATER OUTLOOK,
K. Jones, and R. Hartman.
Irrigation Journal, Vol. 33, No. 4, p 21-23, July/August, 1983. 1 Fig, 1 Tab.

Descriptors: *Water supply, *Basins, Western United States, Snowpack, Snowmelt, Sierra Nevada Mountains, North Carolina, San Joaquin Valley, Tulare Lake, River basins, Great Salt Lake, Columbia River, Pacific basins, Rio Grande Basin, Missouri River, Colorado River, Arkansas River Basin, Runoff.

In the Sacramento, North Carolina, San Joaquin and Tulare Lake Basins, runoff for this water year is predicted to be at or near record volumes. The water supply outlook for the Great Basin calls for a more than adequate supply. The water supply forecasted for the Columbia River and Pacific coastal basins will be adequate for most users in the area. The Rio Grande Basin water supply outlook calls for near normal to much above normal runoff. Streamflow forecasts in the Missouri Basin generally call for below average runoff except in the Platte Basin where streamflow should reach from 80 to 138% of average. The outlook for the Colorado Basin is near normal while that for the Arkansas Basin is for very good amounts of runoff. (Baker-IVI)
W84-04139

OVERLAND FLOW ON CONVERGING AND DIVERGING SURFACES - ASSESSMENT OF NUMERICAL SCHEMES,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
S. Y. Campbell, and J. -Y. Parlange.
Journal of Hydrology, Vol. 70, No. 1-4, p 265-275, 1984. 3 Fig, 1 Tab, 6 Ref.

Descriptors: *Overland flow, *Mathematical equations, Model studies, Flow, Streamflow, Channel flow.

The similarity solutions of the equations of kinematic flow on a cone-shaped surface, provide a means for checking the numerical models used for converging and diverging flows. A way of determining the accuracy of the numerical models has been demonstrated, using the similarity solution for diverging flow. The error evident in the initial stages of two schemes considered was decreased dramatically if the initial stages of the excess rainfall curve were described as some power of time. This part of the calculations could be replaced by a simple asymptotic expansion, thus saving in computational time and increasing the accuracy of the results. (Baker-IVI)
W84-04155

2F. Groundwater

EVALUATION OF THE RESPONSE OF THE BIG SIOUX AQUIFER TO EXTREME DROUGHT CONDITIONS IN MINNEHAHA COUNTY, SOUTH DAKOTA,
Geological Survey, Huron, SD. Water Resources Div.
N. C. Koch.
USGS Water-Resources Investigations Report 83-4235, 1983. 6 p, 2 Fig, 1 Tab, 1 Ref.

Descriptors: *Computer models, *Aquifers, *Surface-groundwater relationships, Minnehaha County, *South Dakota, *Drought.

The Big Sioux aquifer in the study area is a 36-square mile, water-table aquifer hydraulically connected to the Big Sioux River. The computer model used in this report was developed in a previous study and is described in the report by the author entitled 'A digital-computer model of the Big Sioux aquifer in Minnehaha County, South Dakota.' Flow-duration data on the Big Sioux River at the Dell Rapids stream-gaging station showed that the streamflow was less than 23 cubic feet per second for 270 days from June 1976 to March 1977. This event was probably the 100-year or greater low-flow event on the Big Sioux River at the Dell Rapids stream-gaging station. A model simulation with no recharge, a dry river, and pumpage from 60 wells at a total pumping rate of 25 million gallons per day stopped after 248 days after a pumping well caused storage to be depleted at a node. A new pumping rate of 24 million gallons per day allowed the model simulation to continue for an additional 31 days. Water-level declines in the Big Sioux aquifer at the end of the model simulation ranged from 2 to 20 feet in the pumped area. Another model simulation was made under the hydrologic conditions determined by calculating averages based on 1970-79 data with pumpage reduced to 2 million gallons per day by shutting down 12 wells in the city well field. The drawdown recovery converted to volume of water amounted to 531 million gallons after 186 days of pumpage at the reduced rate. (USGS)
W84-03550

GROUND-WATER RESOURCES OF COASTAL CITRUS, HERNANDO, AND SOUTHWESTERN LEVY COUNTIES, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
J. D. Fretwell.
USGS Water-Resources Investigations Report 83-4079, 1983. 87 p, 30 Fig, 7 Tab, 77 Ref.

Descriptors: *Groundwater, *Water quality, Aquifer characteristics, Karst terrain, Carbonate aquifer, Hydrogeology, Coastal springs, Marshes, Hernando County, *Florida, Citrus County, Levy County, Floridan aquifer.

Ground water in the coastal parts of Citrus, Hernando, and Levy Counties is obtained almost entirely from the Floridan aquifer. The aquifer is unconfined near the coast and semiconfined in the ridge area. Transmissivity ranges from 20,000 feet squared per day in the ridge area to greater than 2,000,000 feet squared per day near major springs. Changes in the potentiometric surface of the aquifer are small between the wet and dry seasons. Water quality within the study area is generally very good except immediately adjacent to the coast where saltwater from the Gulf of Mexico poses a threat to freshwater supply. This threat can be compensated for by placing well fields a sufficient distance away from the zone of transition from saltwater to freshwater so as not to reduce or reverse the hydraulic gradient in that zone. Computer models are presently available to help predict the extent of influence of ground-water withdrawals in an area. These may be used as management tools in planning ground-water development of the area. (USGS)
W84-03551

HYDROGEOLOGY OF THE SARASOTA-PORT CHARLOTTE AREA, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
R. M. Wolansky.
USGS Water-Resources Investigations Report 82-4089, 1983. 48 p, 17 Fig, 7 Tab, 61 Ref.

Descriptors: *Hydrogeology, *Groundwater geology, Geologic mapping, Aquifers, *Aquifer characteristics, Water quality, Water budget, Hydrologic model, *Florida, Southwest Florida Water Management District, Charlotte County, De Soto County, Sarasota County, Floridan aquifer, Intermediate aquifers, Confining beds, Surficial aquifer.

The surficial and intermediate aquifers are the major source of public water supplies in the Sarasota-Port Charlotte, Florida, area because of the relatively poor quality of Floridan aquifer water. The hydrogeologic framework consists of the surficial aquifer, intermediate aquifers (Tamiami-upper Hawthorn and lower Hawthorn-upper Tampa aquifers) and confining beds, Floridan aquifer, and lower confining bed (or base of the Floridan aquifer). The quality of ground water in the surficial and intermediate aquifers is generally good, except in the western (coastal) and southern parts where saltwater intrusion or incomplete flushing of connate water has occurred. The mineral content of ground water generally increases with depth and areally from the northeast towards the west and south. A water budget for the study area shows that an average annual rainfall of 51.0 inches minus an evapotranspiration of 38.0 inches per year and streamflow of 12.5 inches per year leaves 0.5 inch per year of recharge to the surficial aquifer. Combined pumpage from the aquifers is 1.06 inches per year. A preliminary quasi-time dimensional model has been applied to the study area to check the reasonableness of the hydrogeologic framework defined and of aquifer parameters. The model was considered calibrated when the final head matrix was within plus or minus 5 feet of the starting head. (USGS)
W84-03554

GEOLOGIC AND WELL-CONSTRUCTION DATA FOR THE H-8 BOREHOLE COMPLEX NEAR THE PROPOSED WASTE ISOLATION PILOT PLANT SITE, SOUTHEASTERN NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
J. G. Wells, and S. L. Drellack, Jr.
USGS Water-Resources Investigations Report 82-4118, 1982. 42 p, 3 Fig, 7 Tab, 11 Ref.

Descriptors: *Cores, *Boreholes, Geologic units, *Radioactive waste disposal, Drillers logs, Waste Isolation Pilot Plant, *New Mexico, Eddy County.

The H-8 complex, a group of three closely-spaced boreholes, is located 9 miles south of the proposed Waste Isolation Pilot Plant site in southeastern Eddy County, New Mexico. The holes were drilled during July, August, and September of 1979 to obtain geologic and hydrologic data to better define the regional ground-water-flow system. The geologic data presented in this report are part of a site-characterization study for the possible disposal of defense-associated radioactive wastes within salt beds of the Salado Formation of Permian age. The geologic data include detailed descriptions of cores, cuttings, and geophysical logs. Each borehole was designed to penetrate a distinct water-bearing zone: H-8a (total depth 505 feet) was completed just below the Magenta Dolomite Member of the Rustler Formation of Permian Age; H-8b (total depth 624 feet) was completed just belows the Culebra Dolomite Member of the Rustler Formation; and H-8c (total depth 808 feet) was completed just below the Rustler Formation-Salado Formation contact. The geologic units penetrated in borehole H-8c are surficial alluvium and eolian sand of Holocene age (0-4 feet); the Mescalero caliche (4-10 feet) and Gatuna Formation (10-153 feet), both of Pleistocene age; and the Dewey Lake Red Beds (153-399 feet), the Rustler Formation (399-733 feet), and part of the Salado Formation penetrated by borehole H-8c is composed of residue from dissolution of halite and associated rocks, and the hydration of anhydrite to gypsum, indicat-

ing that the eastward-moving dissolution front on top of the Salado, found just to the west of the WIPP site, has reached the H-8 site. (USGS)
W84-03555

GEOLOGIC AND WELL-CONSTRUCTION DATA FOR THE H-9 BOREHOLE COMPLEX NEAR THE PROPOSED WASTE ISOLATION PILOT PLANT SITE, SOUTHEASTERN NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
S. L. Drellack, Jr., and J. G. Wells.
USGS Water-Resources Investigations Report 82-4111, 1982. 32 p, 3 Fig, 7 Tab, 12 Ref.

Descriptors: *Cores, *Boreholes, Geologic units, *Radioactive waste disposal, Drillers logs, Waste Isolation Pilot Plant, *New Mexico, Eddy County.

The H-9 complex, a group of three closely spaced boreholes, is located 5.5 miles south of the proposed Waste Isolation Pilot Plant (WIPP) site in east-central Eddy County, New Mexico. The holes were drilled during July, August, and September 1979 to obtain geologic and hydrologic data to better define the regional ground-water-flow system. The geologic data presented in this report are part of a site-characterization study for the possible storage of defense-associated radioactive wastes within salt beds of the Salado Formation of Permian age. The geologic data include detailed descriptions of cores, cuttings, and geophysical logs. Each borehole was designed to penetrate a distinct water-bearing zone: H-9a (total depth 559 feet) was completed just below the Magenta Dolomite Member of the Rustler Formation; H-9b (total depth 708 feet) was completed just below the Culebra Dolomite Member of the Rustler Formation; H-9c (total depth 816 feet) was completed below the Rustler Formation-Salado Formation contact. The geologic units penetrated in borehole H-9c are eolian sand of Holocene age (0-5 feet); the Gatuna Formation of Pleistocene age; (5-25 feet); and the Dewey Lake Red Beds (25-455 feet), the Rustler Formation (455.791 feet), and part of the Salado Formation (791-816 feet), all of Permian age. Three sections (494-501 feet, 615-625 feet, 692-712 feet) in the Rustler Formation penetrated by borehole H-9c are composed of remnant anhydrite (locally altered to gypsum) and clay and silt residue from the dissolution of much thicker seams of argillaceous and silty halite. This indicates that the eastward-moving dissolution within the Rustler Formation, found just to the west of the WIPP site, is present at the H-9 site. (USGS)
W84-03561

SIMULATED CHANGES IN WATER LEVEL IN THE MINJUR AQUIFER, RIYADH AREA, SAUDI ARABIA,
Geological Survey, Riyadh (Saudia Arabia). Water Resources Div.
J. F. Williams, III, and I. Al-Sagaby.
USGS Open-File Report 82-371 and Saudi Arabia Ministry of Agriculture and Water, Water Study Series No. 2, 1982. 34 p, 14 Fig, 6 Tab, 15 Ref.

Descriptors: *Aquifers, *Computer models, *Well fields, *Deep-well pumping, *Water levels, Calibrations, Potentiometric level, *Saudi Arabia, Riyadh, Minjur aquifer, Middle East.

A two-dimensional finite-difference computer model of the Minjur aquifer in the Riyadh area of Saudi Arabia was developed to simulate and predict drawdown in an aquifer which, in 1979, supplied more than 80 percent of all water used in this capital area. The Minjur was modeled as a confined aquifer recharged by leakage through underlying confining beds. Pumpage was simulated for a 23-year period during which it increased from 2,160 to 220,000 cubic meters per day. At Riyadh, the top of the Minjur aquifer is about 1200 meters below land surface. Aquifer thickness within the 40,000-square-kilometer study area ranges from 74 to 138 meters inclusively. Values for aquifer characteristics used in the model are: transmissivity, from 0.001 to 0.0062 square meters per second; storage coefficients, 0.07 for the unconfined, and 0.0004 for the confined sectors of the model area. A value of 0.02 meters per second was used to represent the vertical conductivity of the confining bed. Predictive simulations indicate that if the Minjur aquifer in the Riyadh area is stressed by estimated future pumpages, static water-level declines ranging from 10 up to and including 90 meters, depending on location, will occur from 1980 through 1999. Simulations also demonstrated that pumping levels in the new Buwayb well field will decline substantially from 1980 through 1981. (USGS)
W84-03571

NUMERICAL SIMULATION OF THE ALLUVIUM AND TERRACE AQUIFER ALONG THE NORTH CANADIAN RIVER, CANTON LAKE TO LAKE OVERHOLSER, CENTRAL OKLAHOMA,
Geological Survey, Oklahoma City, OK. Water Resources Div.
S. C. Christenson.
USGS Water-Resources Investigations Report 83-4076, 1983. 36 p, 17 Fig, 4 Tab, 15 Ref.

Descriptors: Hydrology, *Model studies, Groundwater mining, *Oklahoma, *Aquifers, *Simulation, North Canadian River.

Alluvium and terrace deposits of Quaternary age, which cover an area of about 400 square miles along the North Canadian River between Canton Lake and Lake Overholser, locally yield 500 gallons per minute to wells. The deposits are as much as 100 feet thick and consist of varying proportions of clay, silt, sand, and gravel, with sand-size sediments dominating. The underlying bedrock is Permian sandstone and shale. A digital model was used to determine the ability of the aquifer to continue to supply water for irrigation, industry, and domestic use. One mile node spacing was used with the block-centered finite-difference model. The aquifer discharge to the North Canadian River and the difference between computed and observed heads was used to calibrate the model. Model simulations using different projected pumping rates show that the alluvium and terrace deposits will contain large amounts of water in storage in 1993 and 2020. However, ground-water discharge to the North Canadian River will decrease. (USGS)
W84-03572

LAND APPLICATION OF WASTEWATER AND ITS EFFECT ON GROUND-WATER QUALITY IN THE LIVERMORE-AMADOR VALLEY, ALAMEDA COUNTY, CALIFORNIA,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 5E.
W84-03573

GROUND-WATER TEMPERATURE OF THE WYOMING QUADRANGLE IN CENTRAL DELAWARE, WITH APPLICATION TO GROUND-WATER-SOURCE HEAT PUMPS,
Geological Survey, Towson, MD. Water Resources Div.
A. L. Hodges, Jr.
USGS Water Resources Investigations Report 82-53, September, 1982. 29 p, 11 Fig, 4 Tab, 24 Ref.

Descriptors: *Water temperature, *Heat pumps, *Groundwater, Seasonal fluctuation, Heat energy, Heat transfer, Aquifers, *Delaware, Wyoming Quadrangle.

Ground-water temperature was measured during a one-year period (1980-81) in 20 wells in the Wyoming Quadrangle in central Delaware. Data from thermistors set at fixed depths in two wells were collected twice each week, and vertical temperature profiles of the remaining 18 wells were made monthly. Ground-water temperature at 8 feet below land surface in well Jc55-1 ranged from 45.0 degrees F in February to 70.1 degrees F in September. Temperature at 35 feet below land surface in the same well reached a minimum of 56.0 degrees F in August, and a maximum of 57.8 degrees F in February. Average annual temperature of ground water at 25 feet below land surface in all wells ranged from 54.6 degrees F to 57.8 degrees F. Variations of average temperature probably reflect the presence or absence of forestation in the recharge areas of the wells. Ground-water-source heat pumps supplied with water from wells 30 or more feet below land surface will operate more efficiently in both heating and cooling modes than those supplied with water from shallower depths. (USGS)
W84-03574

GEOLOGY OF THE TULARE FORMATION AND OTHER CONTINENTAL DEPOSITS, KETTLEMAN CITY AREA, SAN JOAQUIN VALLEY, CALIFORNIA, WITH A BRIEF SECTION ON GROUND-WATER MANAGEMENT CONSIDERATIONS AND USE OF TEXTURE MAPS,
Geological Survey, Menlo Park, CA. Water Resources Div.
R. W. Page.
USGS Water-Resources Investigations Report, 83-4000, May, 1983. 24 p, 11 Fig, 1 Tab, 47 Ref.

Descriptors: *Geologic formations, *Structural geology, *Aquifers, *Groundwater, Electrical well logging, Tertiary Period, Quaternary Period, *Texture maps, *Tulare Formation, Fossils, San Joaquin Valley, *California.

The Tulare Formation and other continental deposits of Pliocene to Holocene age crop out over most of the area near Kettleman City in the San Joaquin Valley of California. The deposits range in thickness from 0 to more than 4,000 feet and overlie the upper Mya zone of the San Joaquin Formation of Pliocene age. Some features of their base reflect structural deformation during Quaternary time. Many freshwater fossils occur in the Tulare Formation itself, including the largest fossil assemblage of clams and snails known on the Pacific Coast. Sediments in the Tulare Formation and other continental deposits consist mainly of unconsolidated deposits of clay, silt, sand, and gravel. Texture maps of the Tulare Formation and other continental deposits show the distribution, both laterally and vertically, of the coarse- and fine-grained sediment in the area. Such maps can be used by water managers for selecting areas for recharge and discharge operations and by groundwater modelers for assigning relative values of hydraulic conductivity and storage coefficient. (USGS)
W84-03575

EFFECTS OF URBAN DEVELOPMENT ON THE AQUIFERS OF THE MEMPHIS AREA, TENNESSEE,
Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 4C.
W84-03586

THERMAL SPRINGS IN THE BOISE RIVER BASIN, SOUTH-CENTRAL IDAHO,
Geological Survey, Boise, ID. Water Resources Div.
R. E. Lewis, and H. W. Young.
USGS Water-Resources Investigations Report, 82-4006, September, 1982. 22 p, 5 Fig, 4 Tab, 19 Ref.

Descriptors: *Geothermal studies, *Idaho, *Thermal springs, *Water temperature, Chemical analyses, Stable isotopes, Radioisotopes, Discharge, Heat loss, Chemical geothermometers, Idaho batholith, *Boise River basin.

The Boise River Basin, characterized by steep, rugged mountains and narrow river valleys, drains an area of about 2,680 square miles in south-central Idaho. Granitic rocks of the Idaho batholith predominate in the basin. Temperature of waters from thermal springs in the basin range from 33 degrees to 87 degrees Celsius, are sodium carbonate type and are slightly alkaline. Dissolved-solids concentrations are less than 280 milligrams per liter. Estimated reservoir temperatures determined by the silica and sodium-potassium-calcium geothermometers range from 50 degrees to 98 degrees Celsi-

us. Tritium concentrations in sampled thermal springs are near zero and indicate these waters were recharged prior to 1954. Stable-isotope data are not conclusive insofar as indicating a source area of recharge for the thermal springs in the basin. Thermal springs discharged at least 4,900 acre-feet of water in 1981, and the associated convective heat flux is 11,000,000 calories per second. (USGS)
W84-03588

TWO-DIMENSIONAL, FINITE-DIFFERENCE MODEL OF THE HIGH PLAINS AQUIFER IN SOUTHERN SOUTH DAKOTA,
Geological Survey, Huron, SD. Water Resources Div.
K. E. Kolm, and H. L. Case, III.
USGS Water-Resources Investigations 83-4175, 1983. 34 p, 13 Fig, 2 Tab, 33 Ref.

Descriptors: *Model studies, Hydrological model, *Computer model, Groundwater, Unconfined aquifer, *South Dakota, High Plains aquifer, Two-dimensional finite-difference model.

The High Plains aquifer is the principal source of water for irrigation, industry, municipalities, and domestic use in south-central South Dakota. The aquifer, composed of upper sandstone units of the Arikaree Formation, and the overlying Ogallala and Sand Hills Formations, was simulated using a two-dimensional, finite-difference computer model. The maximum difference between simulated and measured potentiometric heads was less than 60 feet (1- to 4-percent error). Two-thirds of the simulated potentiometric heads were within 26 feet of the measured values (3-percent error). The estimated saturated thickness, computed from simulated potentiometric heads, was within 25-percent error of the known saturated thickness for 95 percent of the study area. (USGS)
W84-03589

GROUND WATER IN THE NORTHEAST PART OF TWENTYNINE PALMS MARINE CORPS BASE, BAGDAD AREA, CALIFORNIA,
Geological Survey, Menlo Park, CA. Water Resources Div.
J. H. Koehler.
USGS Water-Resources Investigations Report 83-4053, July, 1983. 15 p, 3 Fig, 2 Tab, 5 Ref.

Descriptors: Water resources, Hydrology, Geology, Driller's logs, *Water quality, *Groundwater, Twentynine Palms Marine Corps Base, *California.

The hydrologic characteristics of the Bagdad area, in the northeast part of Twentynine Palms Marine Corps Base, were investigated to determine the feasibility of obtaining a supply of ground water. Five test holes were drilled and three of these were completed with 6-inch casings. Ground water in the eastern part of the study area is high in dissolved solids; water from well 5N/11E-36H1 contains 252,000 milligrams per liter of dissolved solids, and well 4N/12E-7R1 contains 21,800 milligrams per liter of dissolved solids. The dissolved-solids concentration in water from the test wells on the west side of Ludlow fault is much lower; the dissolved solids in water from the three test wells ranges from 669 to 961 milligrams per liter. The recommended limits for chloride and fluoride were exceeded in water from test well 4N/10E-21K1, arsenic and fluoride in water from well 5N/9E-3B1, and chloride in water from test well 6N/9E-34F1. An estimated 640,000 acre-feet of water is stored in the alluvium west of the Ludlow fault, sufficient to provide for several small diameter wells for many years. (USGS)
W84-03593

FRONT-TRACKING MODEL FOR CONVECTIVE TRANSPORT IN FLOWING GROUND WATER,
Geological Survey, Reston, VA. Water Resources Div.
S. P. Garavedian, and L. F. Konikow.
USGS Water-Resources Investigations Report 83-4034, 1983. 55 p, 3 Ref.

Descriptors: *Groundwater, *Groundwater pollution, *Computer models, *Groundwater movement, *Solute transport, Front-tracking model, *Aquifer characteristics.

A finite-difference numerical model that simulates the convective transport of water or tracer particles through porous media is described. It can be applied to one- or two-dimensional problems involving either steady-state or transient flow. The model tracks representative water or tracer particles, initially located along specified lines, as they move in response to the groundwater velocity filed. Aquifer properties may be both anisotropic and nonhomogeneous. Included in the report is a listing of the program along with input formats and test problem results. The front-tracking model provides a useful first approximation determining the movement of solutes in an aquifer, particularly in cases when dispersion and dilution is of minor consideration. (USGS)
W84-03594

PRELIMINARY APPRAISAL OF THE HYDROLOGY OF THE ROCK ISLAND AREA, LE FLORE COUNTY, OKLAHOMA,
Geological Survey, Oklahoma City, OK. Water Resources Div.
M. V. Marcher, D. L. Bergman, J. D. Stoner, and S. P. Blumer.
USGS Water-Resources Investigations Report 83-4013, 1983. 35 p, 10 Fig, 9 Tab, 17 Ref.

Descriptors: *Strip mines, *Strip mine wastes, *Mine drainage, Water pollution effects, Coal mines, Water quality, *Oklahoma, Rock Island, James Fork, McAlester, Hartshorne, Atoka, Le-Flore County.

In Rock Island area bedrock, which consists of shale, siltstone, and sandstone, contains water under artesian conditions. Because the rocks have minimal permeability, well yields probably are less than 5 gallons per minute. Groundwater commonly is mixed cation/bicarbonate type with dissolved solids ranging from about 300 to 1,250 milligrams per liter near Williams, Oklahoma, and 322 milligrams per liter near Hackett, Arkansas. The chemical quality of water in James Fork has not been greatly affected by man. Potential hydrologic effects of surface mining included, (1) additional water storage in surface mine ponds; (2) changes in rock permeability and groundwater storage; (3) changes in runoff and streamflow characteristics; (4) changes in drainage patterns; and (5) changes in the chemical quality and sediment loads of streams. (USGS)
W84-03595

GROUND WATER IN THE NORTHERN PART OF CLACKAMAS COUNTY, OREGON,
Geological Survey, Portland, OR. Water Resources Div.
A. R. Leonard, and C. A. Collins.
USGS Open-File Report 80-1049, 1983. 85 p, 11 Fig, 4 Tab, 15 Ref.

Descriptors: *Groundwater, *Oregon, Water level fluctuations, Aquifers, *Domestic water, *Specific capacity, Perched water, Natural recharge, *Basalt wells, *Suburban water supplies, *Well yield, Chemical analyses, Bacterial contamination.

The number of domestic wells and domestic-water use have increased rapidly since 1960 in the 250-square-mile study area southeast of Portland, Oregon. The rolling upland area is underlain by volcanic and stream-deposited rocks, all units of which serve as aquifers locally. Depths of wells range from less than 50 to more than 1,000 feet and yields from less than one to several hundred gallons per minute. Local recharge rates are judged to be adequate for any forseeable projected development for domestic water supplies. Wells are expected to yield adequate water for domestic needs nearly everywhere in the study area. However, some exploration, as by test drilling, may be needed in siting irrigation, industrial, or public-supply wells of moderate to high yield. Additional ground water can be developed from all aquifers, but the Columbia River Basalt Group is considered susceptible to problems of overdevelopment locally. (USGS)
W84-03602

BASE FLOW AND GROUND WATER IN UPPER SWEETWATER VALLEY, TENNESSEE,
Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 2E.
W84-03605

HYDROLOGY OF THE LITTLE ANDROSCOGGIN RIVER VALLEY AQUIFER, OXFORD COUNTY, MAINE,
Geological Survey, Boston, MA. Water Resources Div.
D. J. Morrissey.
USGS Water-Resources Investigations 83-4018, 1983. 79 p, 20 Fig, 14 Tab, 26 Ref.

Descriptors: *Groundwater model, Two-dimensional, Aquifer, Logic cycle, Groundwater quality, Groundwater contamination, Little Androscoggin River valley aquifer, Sludge disposal, Aquifer geometry, *Maine.

The Little Androscoggin River valley aquifer, a 15-square-mile sand and gravel valley-fill aquifer in southwestern Maine, is the source of water for the towns of Norway, Oxford, and South Paris. Estimated inflows to the aquifer during the 1981 water year were 16.4 cubic feet per second from precipitation directly on the aquifer, 11.2 cubic feet per second from till covered uplands adjacent to the aquifer, and 1.4 cubic feet per second from surface-water leakage. Outflows from the aquifer were 26.7 cubic feet per second to surface water and 2.3 cubic feet per second to wells. A finite-difference ground-water flow model was used to simulate conditions observed in the aquifer during 1981. Model conditions observed in the aquifer during 1981. Model simulations indicate that a 50 percent reduction of average 1981 recharge to the aquifer would cause water level declines of up to 20 feet in some areas. Model simulations of increased pumping at a high yield well in the northern part of the aquifer indicate that resulting changes in the water table will not be sufficient to intercept groundwater contaminated by a sludge disposal site. Water in the aquifer is low in dissolved solids (average for 38 samples was 67 mg/L), slightly acidic and soft. Ground-water contamination has occurred near a sludge-disposal site and in the vicinity of a sanitary landfill. Dissolved solids in ground water near the sludge disposal site were as much as ten times greater than average background values for the aquifer. (USGS)
W84-03607

GROUND-WATER RESOURCES OF THE RUTLAND AREA, VERMONT,
Geological Survey, Boston, MA. Water Resources Div.
R. E. Willey, and D. Butterfield.
USGS Water-Resources Investigations Report 82-4057, 1983. 38 p, 7 Fig, 8 Tab, 40 Ref.

Descriptors: *Groundwater, *Aquifers, *Hydrogeology, Wells, Bedrock, Water quality, Rutland, *Vermont.

Ground water in the Rutland area occurs both in the bedrock and the overlying unconsolidated glacial deposits. Bedrock in the area is composed of a series of metamorphic and igneous rocks. Water from wells drilled in bedrock can be obtained in sufficient quantities for domestic use nearly anywhere in the area. The median well yield for 4 different bedrock hydrogeologic units ranges from 2 to 7 gallons per minute. Unconsolidated deposits in the Rutland area include till, clay, sand, and gravel. Saturated sand and gravel capable of yielding more than 200 gallons per minute is found in the major valleys of the area. Chemical analyses of water from 72 wells indicate that 29 percent of these sources contain one or more constituents that exceed the limits recommended by the U.S. Environmental Protection Agency (1977, 1978) for

public drinking water supplies. The most common problem constituents are iron and manganese. In addition, elevated levels of chloride and nitrate suggest that 65 percent of the sampled sources have some water-quality deterioration. (USGS)
W84-03609

GEOLOGY AND WATER RESOURCES OF MCPHERSON, EDMUNDS, AND FAULK COUNTIES, SOUTH DAKOTA, PART II, WATER RESOURCES,
South Dakota State Geological Survey, Vermillion.
L. J. Hamilton.
South Dakota Geological Survey (Vermillion), Bulletin 26, 1982. 60 p, 26 Fig, 5 Tab, 25 Ref.

Descriptors: *Groundwater, *Aquifers, *Wells, Water supply, *Aquifer characteristics, Water quality, Storage, McPherson County, Edmunds County, Faulk County, *South Dakota.

A large supply of water, which generally is adequate for most uses, is available from lakes, ponds, streams, and glacial and bedrock aquifers in McPherson, Edmunds, and Faulk Counties. The area comprises 3,300 sq mi (8,550 sq km) of till plains in north-central South Dakota. Lakes and ponds store about 70,000 acre-ft (86 million cu m) per year. However, surface-water supplies are greatly depleted by evapotranspiration in summer drought. Glacial aquifers of sand and gravel store about 5.5 million acre-ft (6.8 cu km) of water. They can yield more than 500 gal/min (32 L/s) to a pumping well at many places. The entire area is underlain by sandstone bedrock aquifers that store about 200 million acre-ft (247 cu km) of water. They can yield 500 gal/min (32 L/s) or more to individual wells. Underlying limestone and dolomite aquifers in the western part of the area also can supply large amounts of water. The quality of both surface and ground water varies greatly but is characterized by high dissolved-solids concentrations and high hardness. Much of the ground water is unsuitable for irrigation use because of high concentrations of dissolved solids, particularly sodium and bicarbonate ions. (USGS)
W84-03650

GROUND-WATER RESOURCES AND GEOLOGY OF DODGE COUNTY, WISCONSIN,
Geological Survey, Madison, WI. Water Resources Div.
R. W. Devaul, C. A. Harr, and J. J. Schiller.
University of Wisconsin-Extension, Geological and Natural History Survey Madison, Information Circular No. 44, 1983. 34 p, 18 Fig, 2 Tab, 22 Ref.

Descriptors: *Groundwater availability, *Geohydrology, *Aquifers, Water quality, Water use, *Wisconsin, Dodge County, Water resources development.

The ground-water resources of Dodge County were evaluated to aid planners meet the needs of growing population and industry. The sand-and-gravel, Silurian dolomite, Galena-Platteville, and sandstone aquifers and the Galena-Platteville aquifer generally range from 100 to 500 gallons per minute. Well yields for the Silurian dolomites, which depend in part on the degree of fracturing, are about 100 gallons per minute. Well yield from the sandstone aquifer generally ranges from 100 to 1,000 gallons per minute. Calcium and bicarbonate are the principal ions in ground water in Dodge County. The water is hard, and the concentration of iron commonly exceeds the recommended limit for drinking water and the desirable concentration for water used for high-pressure boiler feed, some food processing, and leather finishing industries. The ground water is generally of suitable chemical quality for domestic, agricultural, and most industrial uses. In 1979, an average of about 13 million gallons of ground water was pumped daily for residential, industrial, commercial, irrigation, stock watering, and other uses. (USGS)
W84-03651

HYDROGEOLOGY OF BUTLER COUNTY, NEBRASKA,
Geological Survey, Lincoln, NE. Water Resources Div.
M. H. Ginsberg.
University of Nebraska, Lincoln, Nebraska Water Survey Paper 55, September, 1983. 78 p, 20 Fig, 2 Tab, 44 Ref.

Descriptors: *Aquifers, Hydrogeology, Paleodivides, Paleovalleys, *Water quality, *Groundwater, *Water availability, Transmissivity, *Nebraska, Butler County, Pleistocene sediments.

This report describes the occurrence, availability, and quality of groundwater in Butler County, (a 584-square-mile area in east-central Nebraska,) and the geologic framework in which the groundwater exists. Nearly all groundwater used in the county is from the principal Pleistocene aquifer system. Some however, is from saturated sandstone of the Dakota Group--the only source of groundwater bedrock in the county. The county is divided into three hydrogeologic regions. Wells producing from 600 to 1,200 gallons per minute usually can be developed in regions I and II, and in parts of region III where major buried paleovalleys occur. Elsewhere in region III, such large-capacity yields are difficult. Thickness of saturated Pleistocene sand and gravel ranges from 0 to 200 feet. Areas of greatest thickness generally correspond with the position buried paleovalleys and thick sequences of sand and gravel overlying divides. Areas of significant high transmissivity--more than 200,000 gallons per day per foot--generally correspond with buried paleovalleys, and areas of negligible low transmissivity generally correspond with divides. Groundwater flow generally is from southwest and west to northeast and southeast, with a total hydraulic-head loss across the county of more than 200 feet. Groundwater in Pleistocene sediments generally is of the calcium bicarbonate or magnesium bicarbonate types with dissolved solids ranging from 300 to 700 milligrams per liter. (USGS)
W84-03652

TUG HILL AQUIFER: A COMMUNITY INVOLVEMENT AND EDUCATION PROGRAM PLAN.
For primary bibliographic entry see Field 6B.
W84-03659

GERAGHTY AND MILLER'S GROUNDWATER BIBLIOGRAPHY, THIRD EDITION,
Geraghty and Miller, Inc., Syosset, NY.
For primary bibliographic entry see Field 10C.
W84-03663

HYDROGEOLOGY, DIGITAL SIMULATION, AND GEOCHEMISTRY OF THE AQUIA AND PINEY POINT-NANJEMOY AQUIFER SYSTEM IN SOUTHERN MARYLAND,
Geological Survey, Towson, MD. Water Resources Div.
F. H. Chapelle, and D. D. Drummond.
Maryland Geological Survey, Baltimore, Report of Investigations 38, 1983. 100 p, 69 Fig, 10 Tab, 58 Ref.

Descriptors: *Aquifer system, *Artesian aquifer, *Coastal plain, Geochemistry, Wells, Groundwater resources, Chemical precipitation, *Maryland, Anne Arundel County, Calvert County, St. Marys County, Charles County, Prince Georges County, Aquia aquifer, Piney Point-Nanjemoy aquifer.

The hydrogeology and ground-water geochemistry of the Aquia and Piney Point-Nanjemoy aquifers in Southern Maryland have been investigated. This study was made in order to evaluate the availability and chemical quality of water from this aquifer system. The Aquia aquifer is Paleocene in age and is a medium- to fine-grained glauconitic quartz sand. In 1980, approximately 6 million gallons of water per day was produced from this aquifer in Southern Maryland. The Piney Point-Nanjemoy aquifer is Eocene in age and is a coarse- to fine-grained glauconitic quartz sand. In 1980, approximately 2 million gallons of water per day was produced from this aquifer in Southern Maryland. Geologic sections obtained during bridge construction across the Chesapeake Bay and the Patuxent River show that Pleistocene River channels have, in places, truncated the Aquia and Piney Point-Nanjemoy aquifers and their confining beds. The erosional truncation is shown to be a major control on the natural head distribution of these aquifers. A quasi three-dimensional digital model was constructed of this aquifer system. Simulations using the model indicate that water levels will decline steadily between 1980 and 2000. (USGS)
W84-03679

GROUND-WATER RESOURCES IN THE CENTRAL PART OF THE FLATHEAD INDIAN RESERVATION, NORTHWESTERN MONTANA,
Geological Survey, Lakewood, CO. Water Resources Div.
A. J. Boettcher.
Available from Montana Bur. of Mines and Geol., Mont. Coll. of Min., Sci., and Tech., Butte, MO 59701; paper copy $5.00. Montana Bureau of Mines and Geology, Butte, Memoir 48, 1982. 28 p, 10 Fig, 7 Tab, 16 Ref.

Descriptors: *Groundwater, Water level fluctuations, Geology, Transmissivity, Water quality, Gravity survey, *Montana, Geohydrology, *Salinity hazard, Sodium hazard, *Indian reservations.

Ground water is the major source of water for domestic and public supply in the area. Where present, Quaternary glacial deposits and alluvium commonly yield water to wells. Wells tapping the glacial deposits produce from 10 to 1,000 gal/min and wells tapping the alluvium produce from 10 to about 400 gal/min. Precambrian rocks generally yield small accounts, less than 10 gal/min of water to wells and springs. Tertiary volcanics and Quaternary lakebed deposits are not known to yield water to wells. Well yields from glacial deposits are unpredictable because of the heterogeneity of the aquifer material. Wells drifted into or adjacent to moraines generally yield small amounts of water. The chemical quality of the ground water is generally good. Dissolved-solids concentration of the ground-water samples analyzed ranged from 46 to 1,070 milligrams per liter. Calcium, sodium, and bicarbonate are the major constituents of the water. Generally, the ground water in the Little Bitterroot River valley is softer than that in the Mission Valley, but iron and manganese concentrations are generally highest in the Little Bitterroot area. (USGS)
W84-03680

GROUND-WATER RESOURCES, CUMBERLAND COUNTY, NEW JERSEY,
Geological Survey, Trenton, NJ. Water Resources Div.
J. G. Rooney.
Special Report No. 34, New Jersey Dept. of Environmental Protection, 1971. 65 p, 13 Fig, 16 Tab, 21 Ref, 1 Append.

Descriptors: *Groundwater level, *Groundwater depletion, *Hydrologic budget, *Water balance, *Water budget, *Aquifer characteristics, Aquifers, Seasonal depletion, Coastal aquifers, Surface-groundwater relations, Wells, Surface water records, Evapotranspiration.

Data on the availability, quantity and utilization of groundwater in Cumberland County, New Jersey are presented. An average annual hydrologic budget was computed for the county. Water gains are: precipitation, 1,050 mgd; surface-water inflow, 142 mgd; ground-water inflow, negligible. Water losses are: evapotranspiration, 685 mgd; surface-water outflow, 370 mgd; groundwater outflow, 137 mgd. Water use in the county is highly seasonal and variable, mainly because of increasing requirements for irrigation and the food processing industries in the county. In 1964, seasonal use ranged from 27 mgd in March to 145 mgd in August. In 1964, withdrawals from Cumberland County averaged about 51 mgd; almost all of this, 49.4 mgd, was from groundwater supplies. Almost all water supplies in the county are obtained from wells tapping shallow groundwater supplies. The total annual water use in 1964 according to type of

use was: public supply, 10.6 mgd; industrial uses, 19.0 mgd; irrigation, 15.4 mgd; suburbal, rural, residential, institutional, farm, and commercial, 5.9 mgd. Unconsolidated and semiconsolidated Coastal Plain sediments, ranging in age from Cretaceous to Holocene, consist of layers of clay, silt, sand and gravel. Aquifers composed mainly of sand and gravel occur in the Potomac Group and Raritan and Magothy Formation, the Wenonah Formation and Mount Laurel Sand, the Piney Point Formation, and the Kirkwood Formation and Cohansey Sand. Some aquifers not currently used may be suitable in the future. (Garrison-Omniplan)
W84-03682

GROUNDWATER RESOURCES OF THE DALLAS-MONMOUTH AREA, POLK, BENTON, AND MARION COUNTIES, OREGON,
Geological Survey, Portland, OR. Water Resources Div.
J. B. Gontheir.
Oregon Water Resources Department, (Salem), Groundwater Report No. 28, 1983. 50 p, 12 Fig, 9 Tab, 32 Ref.

Descriptors: *Aquifers, *Groundwater, *Hydrogeology, Water wells, Water yield, Water quality, Water use, Willamette Valley, Willamette River, *Oregon.

Tertiary consolidated rocks consisting of marine sandstone, siltstone, shale, tuff, basalt, and gabbro are poorly permeable and yield only small quantities of water to wells. The median yield of wells completed in basalt and in marine sedimentary rocks was 7 and 5 gallons per minute, respectively. About 6 percent of the wells drilled in basalt and 14 percent of the wells drilled in marine sedimentary rocks were reported to be dry holes. The best aquifers in the Dallas-Monmouth area are sand and gravel beds in unconsolidated deposits underlying the lowlands. The most productive sand and gravel aquifer underlies the flood plain of the Willamette River. The aquifer is continuous beneath the entire flood plain and ranges from 10 to 45 feet in thickness and will yield 100 to 500 gallons per minute to properly constructed wells. (USGS)
W84-03687

APPRAISAL OF WATER RESOURCES IN THE UPPER VERDE RIVER AREA, YAVAPAI AND COCONINO COUNTIES, ARIZONA,
Geological Survey, Tucson, AZ. Water Resources Div.
S. J. Owen-Joyce, and C. K. Bell.
Arizona Department of Water Resources, Phoenix, Bulletin No. 2. 219 p, 14 Fig, 15 Tab, 51 Ref.

Descriptors: *Groundwater, *Aquifers, *Water levels, *Water wells, *Base flow, *Perennial streams, *Water quality, Arsenic, Sulfate, Hydrologic budget, *Arizona, Seasonal variation, Geology, *Data collections, Upper Verde River area, Verde Valley, Verde River, Verde Formation, Yavapai County, Coconino County.

Future development of a water supply will depend on the regional aquifer that supplies water to most of the 2,600-square-mile upper Verde River area. The regional aquifer includes the alluvium along the Verde River, Verde Formation, Coconino Sandstone, Supai Formation, Naco Formation, Redwall Limestone, Martin Formation, and Tapeats Sandstone. Depth to water is generally less than 800 feet. Other aquifers provide local perched sources of water. Base flow in the Verde River and its tributaries is maintained by ground water. Winter base flow has remained unchanged, which indicates the system is in equilibrium. The groundwater budget comprises 111,000 acre-feet of base flow, 35,000 acre-feet lost to evapo-transpiration, 31,000 acre-feet of surface water for irrigation, and 8,000 acre-feet of ground water withdrawn for public and domestic use. Ground water and surface water are of acceptable chemical quality for most uses except near Camp Verde. Dissolved solids, sulfate, arsenic, and fluoride in water from the Verde Formation and alluvium exceed the maximum contaminant levels for drinking water. The Verde Formation contains evaporite deposits, and arsenic is associated with clay minerals. The salinity hazard of irrigation water is medium to high in the Verde River downstream from Camp Verde. (USGS)
W84-03689

GEOHYDROLOGY AND WATER USE IN SOUTHERN APACHE COUNTY, ARIZONA,
Geological Survey, Tucson, AZ. Water Resources Div.
L. J. Mann, and E. A. Nemecek.
Arizona Deparment of Water Resources, Phoenix, Bulletin 1, January, 1983. 86 p, 8 Fig, 9 Tab, 19 Ref.

Descriptors: *Groundwater, *Water levels, *Aquifers, *Water utilization, *Water wells, *Water quality, Water analysis, Data collection, *Arizona, Apache County.

In 1975 about 30,000 acre-feet of water--70 percent surface water and 30 percent ground water--was used in the 4,100-square-mile area of southern Apache County. Water use is expected to increase nearly 100 percent by the mid-1980's. Ground water will be used to meet the future demands because most of the surface water is allocated to local and downstream users. The most widespread source of ground water is the Coconino aquifer, which probably underlies the entire area. In 1975 the aquifer furnished about 7,700 acre-feet of water to pumping and flowing wells, and in general, no appreciable decline in water levels has taken place. In the southwestern and west-central parts, the water contains moderate concentrations of dissolved solids; in the southeastern and east-central parts the water generally contains large concentrations of dissolved solids. (USGS)
W84-03690

VARIABILITY OF SURFACE RECHARGE AND ITS EFFECTS ON GROUNDWATER IN SUFFOLK COUNTY, LONG ISLAND,
Cornell Univ., Ithaca, NY. Center for Environmental Research.
For primary bibliographic entry see Field 5B.
W84-03693

GROUND-WATER RESOURCES OF THE PINEY POINT AND CHESWOLD AQUIFERS IN CENTRAL DELAWARE AS DETERMINED BY A FLOW-MODEL,
Geological Survey, Trenton, NJ. Water Resources Div.
P. P. Leahy.
Delaware Geological Survey, Newark, Bulletin No. 16, July, 1982. 68 p, 34 Fig, 5 Tab, 33 Ref.

Descriptors: *Model studies, *Confined aquifers, *Groundwater management, *Aquifer characteristics, Coastal Plain, *Delaware, Kent County.

A ground-water flow model was constructed to simulate the response of the Piney Point and Cheswold aquifers in central Delaware to withdrawals of water. The calibration was accomplished by matching model outputs with observed heads at steady-state and transient conditions. The aquifer system was assumed to be in equilibrium with a pumpage of 2.2 Mgal/d prior to the early 1950's. A steady-state simulation of this condition was used to refine estimates of the transmissivities and vertical hydraulic conductivities of the aquifers and confining beds. Transient simulation of pumpage from 1952 to 1977 was used to refine estimates of storage coefficients and specific storages of the aquifers and confining beds. The calibration involved comparison of (1) simulated and observed hydrographs at 17 observation wells. Calibration of the model showed that (1) the transmissivity of the Cheswold aquifer ranges from 7,400 sq ft/d to less than 1,000 sq ft/d in the Dover area, and (2) the vertical hydraulic conductivity of the confining bed separating the Cheswold and unconfined aquifers ranges from 0.0004 ft/d to 0.0012 ft/d. An area of high vertical conductivity in the confining bed between the Cheswold and unconfined aquifers is located about 2 miles northwest of Dover. (USGS)
W84-03695

HYDROLOGY AND MODEL EVALUATION OF THE PRINCIPAL ARTESIAN AQUIFER, DOUGHERTY PLAIN, SOUTHWEST GEORGIA,
Geological Survey, Atlanta, GA. Water Resources Div.
L. R. Hayes, M. L. Maslia, and W. C. Meeks.
Georgia Geologic Survey, Atlanta, Bulletin 97, 1983. 93 p, 45 Fig, 19 Tab, 43 Ref.

Descriptors: *Water levels, *Groundwater, Runoff, *Computer model, Hydrographs, *Aquifer, Confining beds, Streamflow, Flow duration, Drought, *Georgia, *Artesian aquifer, Dougherty Plain, Ocala Limestone, Potentiometric surface map, Residuum.

Use of ground water for irrigation in the Dougherty Plain area (4,400 square miles) of southwest Georgia increased from 47 billion gallons in 1977 to 76 billion gallons in 1980, and to 113 billion gallons during the drought year of 1981. Other use of ground water is about 6 billion gallons per year. The surficial material of the Dougherty Plain area consists of about 25 to 125 feet of sandy clay residuum derived from solution weathering of the Ocala Limestone. The principal artesian aquifer underlies this residuum and is the primary source of water, with wells commonly yielding 1,200 gallons per minute. A two-dimensional finite difference model was used to simulate flow in the aquifer. Simulation of a 3-year drought with irrigation pumpage of 113 billion gallons per year resulted in a mean water level decline of 26 feet. Increasing pumpage, to 408 billion gallons per year, resulted in a mean decline of 33 feet. A 10-year simulation using average recharge and pumpage of 287 billion gallons per year resulted in a mean water-level decline of 4 feet. Ground-water discharge to streams declined substantially during drought simulations because of severely reduced recharge from rainfall and increased pumpage. (USGS)
W84-03699

ROUTING TECHNIQUE FOR ESTIMATING GROUND-WATER RECHARGE,
Moratuwa Univ. (Sri Lanka). Dept. of Civil Engineering.
D. C. H. Senarath, and K. R. Rushton.
Ground Water, Vol. 22, No. 2, p 142-147, March-April, 1984. 8 Fig, 1 Tab, 9 Ref.

Descriptors: *Groundwater recharge, *Estimating, Aquifers, Recharge, Clay, Precipitation, Evapotranspiration, Soil water, Mathematical models, England.

A technique is presented for the estimation of groundwater recharge in a region where the formations overlying an aquifer cannot transmit all of the available water to the aquifer. The method is based on a routing model which is derived from the physical nature of formations overlying the aquifer. The model takes into account precipitation, evapotranspiration, soil moisture balance and the passage of water through strata such as boulder clay. The validity of the model is tested by calculated and field stream flow hydrographs. The study area is a chalk aquifer in southeast England in which several complex formations overlying the aquifer restrict the quantity of potential recharge that can actually reach the aquifer. Recharge to an aquifer may be significantly less than the maximum potential recharge. Recharge in the study area, as calculated from a standard soil moisture balance, averages 79.7 megl/day. Using the model described, which considers the nature of the overlying strata and the inability of the aquifer to accept all of the available water, the actual magnitude of recharge is found to average 13.5 megl/day. (Baker-IVI)
W84-03757

OBSERVED DRAWDOWN PATTERN AROUND A WELL PARTIALLY PENETRATING A VERTICALLY EXTENSIVE WATER-TABLE AQUIFER,
King Abdulaziz Univ., Jeddah (Saudi Arabia). Faculty of Earth Sciences.
S. A. S. Sayed.

Ground Water, Vol. 22, No. 2, p 148-153, March-April, 1984. 12 Fig, 1 Tab, 12 Ref.

Descriptors: *Aquifers, *Drawdown, Pakistan, Spatial distribution, Monitoring wells, Pumping tests, Wells, Pakistan.

A specially designed pumping test was carried out in Pakistan in order to understand the flow pattern around a pumping well partially penetrating a vertically extensive aquifer. The test site was located near Kazi Ahmed, a town about 150 miles northeast of Karachi. The thickness of the aquifer is unknown but may be regarded as practically infinite. The distance beyond which the flow is likely to be horizontal increases with a decrease in the degree of aquifer penetration. In equidistant observation wells open at different depths the drawdowns tend to merge at larger times, provided the observation point is located within the screened section of the aquifer; the less the depth of penetration is, the earlier the drawdowns start merging; and the initial rate of drawdown near the aquifer top is slow but catches up with time to exceed those at deeper points. (Baker-IVI)
W84-03758

HYDROLOGICAL EFFECTS OF GRAVEL WINNING IN AN AREA WEST OF LONDON, UNITED KINGDOM,
Thames Water Authority, Reading (England). Thames Conservancy Div.
M. Morgan-Jones, S. Bennett, and J. V. Kinsella.
Ground Water, Vol. 22, No. 2, p 154-161, March-April, 1984. 6 Fig, 4 Tab, 9 Ref.

Descriptors: *Groundwater, *Water quality, *Environmental effects, Water resources development, Gravel, Lower Colne Valley, England.

The groundwater flow and quality of extensive gravel deposits in the Lower Colne Valley, near London, England are described. The gravels have been heavily exploited during the last several years with the worked out pits being either left water filled for recreational purposes, or filled with a variety of waste materials. Both uses have altered the groundwater situation either by locally lowering or raising groundwater levels. In cases where the scale of pit development or landfilling is large as in the Lower Colne Valley, then remedial measures have to be undertaken to minimize the pollution risk and to obviate problems caused by raised or lowered groundwater levels. Infilled pits and sealed storage reservoirs either reduce the effective permeability and storativity of part of the aquifer or act as total barriers to groundwater flow, leading to the raising of levels upgradient and lowering levels downgradient of such obstructions. The provision of relief channels around such obstructions will provide a satisfactory solution to any potential high water table. (Baker-IVI)
W84-03759

STUDY OF CONFINED FLOW OF GROUND WATER THROUGH A TUNNEL,
Kyushu Univ., Fukuoka (Japan). Dept. of Civil Engineering.
T. Chisyaki.
Ground Water, Vol. 22, No. 2, p 162-167, March-April, 1984. 13 Fig, 2 Tab, 3 Ref.

Descriptors: *Confined flow, *Flow, *Tunnels, *Groundwater flow, Finite element method, Mathematical studies, Permeability.

A reductive finite element method was used to analyze confined flow of groundwater through a tunnel, which might be encountered in tunneling under the bottom of a sea or river. The rate and potential distribution of the confined flow of groundwater through an opening are obtained in connection with the permeability of rock masses, the thickness of covered ground, the location of impermeable bedrock, and other variables. Flow through an opening in the ground with highly permeable masses and discharge of ground water through a tunnel in grouted masses are illustrated, and some useful results for the practical application of tunneling work are obtained. In practical cases of varying thickness of covered ground that might be encountered in the field, discharge through a tunnel increases in proportion to increasing thickness of covered ground and depth of overlying water. Discharge of groundwater through a tunnel increases with lowering of impermeable rocks below th bottom of the tunnel. Discharge through a tunnel increases steeply with the existence of highly permeable masses within the distance of five times the radius of the tunnel from the center of the tunnel. In sealing by grouting, the grouted area should be limited to the diameter of the tunnel. The effect of sealing is smaller in isotropic permeable ground than in orthotropic permeable ground. (Baker-IVI)
W84-03760

MODEL OF REGIONAL GROUND-WATER FLOW IN SECONDARY-PERMEABILITY TERRANE,
Geological Survey, Harrisburg, PA.
J. M. Gerhart.
Ground Water, Vol. 22, No. 2, p 168-175, March-April, 1984. 6 Fig, 1 Tab, 3 Ref.

Descriptors: *Groundwater flow, *Permeability, Soil water, Soil properties, River basins, Susquehanna River, Pennsylvania, Maryland, Unconfined aquifers, Aquifers, Porosity.

Groundwater flow through the Lower Susquehanna River Basin in Pennsylvania and Maryland was analyzed with standard continuum modeling methods. The system is conceptualized as an unconfined aquifer in which groundwater flows in local systems, with recharge occurring nearly everywhere and discharge occurring along stream valleys. Two layers and 21 hydrogeological units were used to represent the flow system. Variations in the degree of development of secondary porosity and permeability are responsible for differences between units in depth to water table, thickness of layers, recharge rate, hydraulic conductivity, stream leakage coefficient, and storativity. The model was calibrated under both steady-state and transient conditions, and was used to evaluate the water supply potential of the 21 hydrogeologic units. The carbonate units have the greatest potential for groundwater development and the Triassic sedimentary and crystalline units have the least potential. A total groundwater yield potential of about 900 million gallons per day could be obtained from the lower basin with a consequent 50% reduction of base flow in streams. (Baker-IVI)
W84-03761

ALGORITHM FOR THEIS SOLUTION,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Water Resources Engineering.
A. D. Gupta, and S. G. Joshi.
Ground Water, Vol. 22, No. 2, p 199-206, March-April, 1984. 2 Fig, 6 Tab, 6 Ref.

Descriptors: *Theis equation, *Aquifer characteristics, Computers, Algorithms, Mathematical studies, Pumping tests.

An algorithm for the Theis solution of pumping test data has been developed taking into account the basic principles of graphical approach of curve-matching. The method is a self-contained one, not requiring initial estimates of transmissivity and storativity. The algorithm is capable of identifying data with errors in observation or recording as demonstrated with the synthetic data sets. By testing the algorithm with several synthetic data sets with varying magnitudes of error and varying distributions of error points in the data set, limitations of the applicability of the algorithm are pointed out. Estimates of aquifer parameters obtained with this algorithm for a typical field test data compare satisfactorily with estimates by the sensitivity approach. The proposed algorithm, apart from the conditions that it does not require initial estimates of aquifer parameters, identifies a group of observations having the best match with the type curve. (Baker-IVI)
W84-03764

MITIGATING WATER SUPPLY PROBLEMS IN THE NIGERIAN BASEMENT COMPLEX: ROLE OF UNDERSTANDING THE GEOHYDROLOGICAL ENVIRONMENT,
Ife Univ. (Nigeria). Dept. of Geography.
E. O. Omorinbola.
Journal of Environmental Management, Vol. 17, No. 3, p 207-221, October, 1983. 6 Fig, 5 Tab, 19 Ref.

Descriptors: *Groundwater, *Water resouces development, *Nigeria, *Basement complex, Regolith, Weathering, Geohydrology, Water supply development.

Although about 70% of Nigeria's population inhabits the Basement Complex areas, only a very small proportion of the communities are provided with pipe-borne water. In rural areas, most people still rely on streams, springs, ponds, and diggings in dry stream beds for their domestic and other water needs. Ways of mitigating the problems by successfully tapping the groundwater resources in the regoliths are specified, using three areas in south-western Nigeria as a case study. Rigorous statistical analysis was used to establish the main characteristics of the geohydrological environment of the regoliths. A widespread groundwater zone exists in the regolith, which implies a high success ratio for waterwell schemes. A direct relationship between saturated zone thickness and weathering depth was noted which implies that wells should penetrate the entire weathering profile to ensure maximum and perennial water yields. Depth to water table significantly increased from the main river channels to the major water divides. This finding conforms with an established geohydrological principle and implies that the depths needed for wells at specific sites in the studied catchments can be reliably predicted in advance of the actual digging or drilling operations. (Baker-IVI)
W84-03770

GROUNDWATER-FLOW PARAMETER ESTIMATION AND QUALITY MODELING OF THE EQUUS BEDS AQUIFER IN KANSAS, U.S.A.,
Kansas State Geological Survey, Lawrence.
M. A. Sophocleous.
Journal of Hydrology, Vol. 69, No. 1-4, p 197-222, February, 1984. 14 Fig, 2 Tab, 21 Ref.

Descriptors: *Groundwater movement, *Model studies, *Equus Beds Aquifer, *Kansas, Aquifers, Salinity, Oil fields, Brines, Brine disposal, Groundwater quality, Mathematical studies, Multiple regression analysis, Hydraulic head, Groundwater pollution.

In recent years it has become clear that the groundwater quality in parts of the Equus Beds aquifer is progressively deteriorating. Because of salinity problems, the City of Burrton found it necessary to construct a new supply well in 1972. The source of this saline water is generally believed to be oil-field brine that leaked from surface disposal ponds during the early history of oil and gas development. The City of Wichita, Kansas, also depends on the Equus Beds aquifer for water. An attempt is made to predict where and how fast the brine plume will move in this area, and what the average chloride concentrations in different parts of the aquifer are. In order to make such predictions, it was necessary to get a calibrated model of the groundwater-flow velocity field. Multiple regression analysis is used for parameter estimation of the steady-state groundwater-flow equation applied in the most critical area of the Equus Beds aquifer. Results of such an analysis produced a correlation coefficient of 0.992 between calculated and observed values of hydraulic head. A chloride transport modeling effort is then carried out despite some serious data deficiencies, the significance of which are evaluated through sensitivity analysis. Thus, starting with the quasi steady-state conditions of the early 1940's, it was possible to match the present chloride distribution satisfactorily. Chloride concentration predictions made for the year 2000 indicate that the quality of the Wichita well-field waters will not generally deteriorate from their present condition. (Murphy-IVI)
W84-03784

RECHARGE OF THE UPPER CHALK AQUIFER AT A SITE IN HAMPSHIRE, ENGLAND; 1. WATER BALANCE AND UNSATURATED FLOW,
Institute of Hydrology, Wallingford (England).
S. R. Wellings.
Journal of Hydrology, Vol. 69, No. 1-4, p 259-273, February, 1984. 7 Fig, 1 Tab, 28 Ref.

Descriptors: *Recharge, *Upper Chalk Aquifer, *Hampshire, *England, Water properties, Chemical properties, Soil moisture deficiency, Unsaturated flow, Permeability coefficient, Field capacity, Water-table profiles, Drainage, Evaporation.

Chalk groundwater is an important water resource in southern and eastern England. Twenty-five percent of all potable water is derived from it. More knowledge is required from the physical processes controlling the movement of water and solutes through the deep unsaturated zone of the Chalk. This would improve the estimation of groundwater available for abstraction and to predict future trends in nitrate levels in the groundwater. Measurements of the annual cycle of changes in water content and potential in the 40 m thick unsaturated zone of Upper Chalk at a site in southern England are described. Measured evaporation continued at the Penman potential rate until the soil-moisture deficit reached 175 mm; this suggested that a root constant of 200 mm would be more appropriate than the much lower values generally used. The validity of the definitions of soil-moisture deficit and root constant depend on that of the field capacity concept. At this site no physically valid reproducible field capacity profile could be defined. The water distribution in the profile represented a continuously changing balance between rainfall inputs, and outputs to evaporation and drainage. The zero flux plane (ZFP) in different years reached depths of between 3 and 6 m. The predominant flow mode through the Upper Chalk is via the fine pores of the matrix. Recharge during the summer normally consists of residual drainage from below the ZFP, at a decreasing rate which allows the water table to fall steadily. The re-establishment in autumn of downward potential gradients throughout the unsaturated zone, and hence the resumption of through drainage, can occur while a significant soil-water deficit still exists and when matric potentials and water contents are so low that fissure flow is very unlikely. (Murphy-IVI)
W84-03786

RECHARGE OF THE UPPER CHALK AQUIFER AT A SITE IN HAMPSHIRE, ENGLAND; 2. SOLUTE MOVEMENT,
Institute of Hydrology, Wallingford (England).
S. R. Wellings.
Journal of Hydrology, Vol. 69, No. 1-4, p 275-285, February, 1984. 4 Fig, 1 Tab, 24 Ref.

Descriptors: *Aquifers, *Recharge, *Chalk Aquifer, *England, Solute transport, Solutes, Leaching, Fertilizers, Nitrates, Chloride, Barley.

A field experiment was conducted to study the movement of solutes through the unsaturated zone of the Chalk, using soil physical techniques to calculate water fluxes and sequential soil coring to measure solute concentrations with depth and time. The amount of fertilizer leached from spring barley below the root zone was about 40 kg N/ha/yr, a mean of the two seasons of the study. Nitrate nitrogen concentrations in the top meter resulting from barley cropping were well above the recommended WHO maximum of 11.3 mg/l. Peak concentrations of solute are attenuated very little in the upper 3 m by diffusion and dispersion. The importance of these mechanisms over periods of decades needs to be assessed since solutes reside in the unsaturated zone at this site for such periods. Nitrate and chloride appear to move at about the same velocity as the water, moving predominantly through the fine pores of the Chalk matrix, at an approximate downward velocity of 0.85 m/yr. (Baker-IVI)
W84-03787

PERTURBATION ANALYSIS OF NEARLY HORIZONTAL FLOWS IN LEAKY AQUIFERS,
Lagos Univ. (Nigeria).
O. Lafe, and O. Oladeji.
Water Resouces Resesarch, Vol. 20, No. 2, p 266-270, February, 1984. 3 Fig, 9 Ref.

Descriptors: *Aquifers, *Groundwater movement, Flow, Perturbation method, Mathematical studies, Permeability, Leaky aquifers.

A parameter perturbation technique has been presented as a convenient way of solving the nonlinear and coupled equations governing flows in leaky aquifers. The perturbation method used is based on the assumption that both aquifers have the same permeability. This assumption can be relaxed and a double parameter perturbation technique developed for the case in which the permeabilities are different. The perturbation technique has emerged as a powerful tool for handling a wide range of flow problems in porous media. The extension of the procedure to unsteady problems is easy. The boundary conditions for the higher-order perturbed differential equations are usually of the homogeneous kind and should present no serious problem for most numerical methods. (Baker-IVI)
W84-03823

WATER QUALITY AT AND ADJACENT TO THE SOUTH DADE COUNTY SOLID-WASTE DISPOSAL FACILITY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 5B.
W84-03846

HYDROLOGY OF THE SAND-AND-GRAVEL AQUIFER, SOUTHERN OKALOOSA AND WALTON COUNTIES, NORTHWEST FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
L. R. Hayes, and D. E. Barr.
Available from the Ofss, USGS, Lakewood, CO 80225, Price: $6.50 paper in copy, $3.50 in microfiche. USGS Water-Resources Investigations Report 82-4110, 1983. 43 p, 13 Fig, 11 Tab, 31 Ref.

Descriptors: *Geohydrology, Water supply, *Aquifers, *Confining bed, Water quality, *Specific capacity, Potentiometric level, Drawdown, Water level, Saline-water intrusion, Limestone, Transmissivity, *Florida, *Okaloosa County, *Walton County, *Sand-and-gravel aquifer, Fort Walton Beach, Water-level declines, *Floridan aquifer.

The sand-and-gravel aquifer in southern Okaloosa and Walton Counties, northwest Florida, extends from land surface to depth of 50 to 150 feet. Intervening layers of clay generally separate the aquifer into an unconfined surficial zone, composed principally of fine to medium sand, and a lower confined zone, consisting of variable amounts of medium to coarse sand and gravel. Well yields of 50 to 500 gallons per minute are possible in most of the area, and yields of 500 to 1,000 gallons per minute can be developed in parts of southwestern Okaloosa County. (USGS)
W84-03847

HYDROLOGIC INFORMATION FOR LAND-USE PLANNING, BADGER ROAD AREA, FAIRBANKS, ALASKA,
Geological Survey, Anchorage, AK. Water Resources Div.
For primary bibliographic entry see Field 5B.
W84-03852

RESULTS OF A TEST WELL IN THE NANAFALIA FORMATION NEAR MELVIN, CHOCTAW COUNTY, ALABAMA,
Geological Survey, Tuscaloosa, AL. Water Resources Div.
M. E. Davis, A. K. Sparkes, and B. S. Peacock.
Available from the Ofss, USGS, Lakewood, CO 80225, Price: $2.75 in paper copy, $3.50 in microfiche. USGS Water-Resources Investigations Report 82-4108, 1983. 17 p, 3 Fig, 2 Tab, 11 Ref.

Descriptors: *Test wells, *Potential water supply, *Sand aquifer, Water quality, Transmissivity, Nanafalia Formation, Melvin, *Alabama, Potentiometric surface.

Test drilling at Melvin, Choctaw County, Alabama, discloses that the Nanafalia Formation (Paleocene) contains freshwater in sand at a distance of 25 miles downdip from the outcrop area. A nearby fault on the north side of Gilberttown-Pickens fault zone does not appear to affect either the head or the water quality in sand of the Nanafalia. This presently undeveloped aquifer could be a source of water supply in this area. (USGS)
W84-03857

HYDROGEOLOGY FOR LAND-USE PLANNING: THE PETERS CREEK AREA, MUNICIPALITY OF ANCHORAGE, ALASAKA,
Geological Survey, Anchorage, AK. Water Resources Div.
For primary bibliographic entry see Field 3B.
W84-03858

BREAKS IN RESISTIVITY SOUNDING CURVES AS INDICATORS OF HARD ROCK AQUIFERS,
Centre for Water Resources, Madras (India).
P. N. Ballukraya, R. Sakthivadivel, and R. Baratan.
Nordic Hydrology, Vol. 14, No. 1, p 33-40, 1983. 5 Fig, 5 Ref.

Descriptors: *Resistivity, *Aquifer characteristics, *Sounding, India, Aquifer testing, Boreholes.

Over eight hundred vertical electrical sounding (VES) curves from areas underlain by granitic gneisses (Peninsular gneisses of archaean age) of southern India were studied and correlated with the lithological logs of borewells drilled at these sounding sites. Both Schlumberger and Wenner electrode configurations were used to carry out vertical soundings and a direct current resistivity meter with a constant current source was used. The VES data was plotted on double logarithimic paper. The depth of investigation for the purpose of estimating depth to aquifers from breaks in VES curves is taken as half the current electrode separation as is the practice in many empirical evaluations. To verify the curve break concept, 188 Schlumberger VES curves were examined. A graph plotted for aquifer depths versus half the current electrode separation at which the breaks occur in the respective sounding curves shows an excellent correlation with a correlation coefficient of 0.94. The method can be applied with confidence for shallow investigations, generally up to about 50 m from ground surface. Beyond this depth it may be ineffective as a thin low resistivity layer present at greater depths may not influence the sounding curve sufficiently so as to be recognized. In highly heterogeneous hard rock areas, lateral inhomogeneities may cause or mask breaks and differentiating from these breaks becomes extremely difficult beyond a certain electrode separation. (Baker-IVI)
W84-03974

SIMULATION OF GROUNDWATER RESPONSE BY CONCEPTUAL MODELS; THREE CASE STUDIES,
Sveriges Meteorologiska och Hydrologiska Inst., Norrkoeping.
S. Bergstrom, and G. Sandberg.
Nordic Hydrology, Vol. 14, No. 2, p 71-84, 1983. 9 Fig, 4 Tab, 6 Ref.

Descriptors: *Aquifer characteristics, *Model studies, *Groundwater, *Simulation, Confined aquifers, Unconfined aquifers, Clay, Recharge, Climate.

Modelling of groundwater responses form climatological data has much in common with conceptual runoff modelling. Both problems require reliable routines for snow accumulation and melt, soil moisture accounting and a response function. A conceptual runoff model is modified and applied to groundwater observations in an unconfined till aq-

uifer, a confined aquifer under a clay deposit and a large unconfined esker aquifer. These types of aquifers can be modelled by one general model structure with only a few options. Much of the variability in response-pattern can be accounted for by a few recession coefficients. As long as the complexity of the model is kept low, as in the case of unconfined aquifers, parameter estimation is not a great problem. But for a confined aquifer the increased complexity and parameter interaction can easily lead to confusing results and modelling may turn to curve-fitting. As a consequence the model for confined conditions is feasable for response simulation only while in the unconfined case the models give a fair estimate of aquifer recharge as well. (Baker-IVI)
W84-03978

FINITE ELEMENT ANALYSIS OF SQUARE AQUIFERS CONTAINING PUMPED WELLS AND COMPARISON WITH FINITE DIFFERENCE METHOD,
Helsinki Univ. (Finland). Dept. of Geophysics.
T. Aberra.
Nordic Hydrology, Vol. 14, No. 2, p 85-92, 1983. 4 Fig, 11 Ref.

Descriptors: *Finite element method, *Aquifers, Pump wells, Drawdown, Mathematical models, Aquifer characteristics.

The finite element method with a 4 node linear quadrilateral isoparametric surface element is used to examine the numerical solution of the behavior of discrete time steps in digital computer analysis of square aquifers containing pumped wells. A wide range of time steps are used in the computation. The calculations show that discrete time steps can cause errors and oscillations in the calculations particularly when wells start and stop pumping. Comparison with known results obtained by theoretical and finite difference procedures has been considered. Particular attention is given to a comparison of the finite element and finite difference simulation results over a regular linear 4 node quadrilateral mesh suitable to represent the two numerical schemes with a marked similarity. The dimensionless time drawdown results of the finite element method agreed well with the finite difference and analytical results for small time increments. However, for large time increments, there are from slight to significant oscillations in the results and notable discrepancies are found in the solutions of the two numerical methods. (Baker-IVI)
W84-03979

DISPERSION OF POLLUTANTS IN SEMI-INFINITE POROUS MEDIA WITH UNSTEADY VELOCITY DISTRIBUTION,
Banaras Hindu Univ., Varanasi (India). Dept. of Mathematics.
For primary bibliographic entry see Field 5B.
W84-03985

RATES AND SOURCES OF 4-HE ACCUMULATION IN GROUNDWATER,
National Physical Research Lab., Pretoria (South Africa). Natural Isotopes Div.
T. H. E. Heaton.
Hydrological Sciences Journal, Vol. 29, No. 1, p 29-47, 1984. 5 Fig, 4 Tab, 19 Ref.

Descriptors: *Aquifers, *Helium radioisotopes, *Groundwater, Radioisotopes, Chemical analysis, Water analysis, Uranium radioisotopes, Radon, Porosity, Aquifer characteristics, Africa, Confined aquifers, Thorium radioisotopes.

H3-4 is produced by the neutralization of alpha particles emitted during decay of radionuclides in an aquifer rock, predominantly by U-238, Th-232, and U-235. The He-4 and Rn-222 contents and C-14 ages were determined for groundwater from two artesian aquifers in southern Africa. Two artesian aquifers, near Uitenhage and Stampriet, were sampled, mainly from free-flowing boreholes. Release of stored helium through weathering, fluxes into the aquifer, and diffusive losses are assessed as to their relative importance to helium derived from the decay of uranium and thorium in the aquifers. A He-4 flux originating from rocks below the aquifer was the most important source. Over the sampled intervals the magnitude of this flux remained relatively constant. While the He-4 data could not be used to calculate the absolute age of the groundwater, it could be used to estimate the relative age and flow direction of very old groundwater if the He-4 flux rate is assumed, or known to be reasonably constant. The Rn-222 data suggests a possibly useful application in the qualitative determination of the uranium content and porosity of aquifers. (Baker-IVI)
W84-04068

WATER TABLE LEVELS AT DIFFERENT DRAINAGE INTENSITIES ON DEEP PEAT IN NORTHERN NORWAY,
Norsk Inst. for Skogforskning, Aas.
F. H. Braekke.
Forest Ecology and Management, Vol. 5, No. 3, p 169-192, March, 1983. 5 Fig, 8 Tab, 21 Ref.

Descriptors: *Drainage effects, *Peat, *Water table, *Reforestation, *Norway, Vegetation, Furrowing, Drainage ditches, Permeability.

Effective drainage is fundamental for successful afforestation of deep, unproductive peatlands. A 10-year study was undertaken on the effects of ditching-systems on water table levels in deep peat. The following factors were tested: ditch depth, ditch distance, vegetation type, surface fall, permeability of peat, air temperature, evaporation and rainfall. Correlation and multiple regression analyses showed that mean water table level midway between ditches for the growing season (June-September) could be predicted with good precision ($R = 0.74 - 0.87$) by: ditch depth, logarithm ($e = 2.7183$) of ditch distance, rainfall, permeability and initial water table level on 1 June (autocorrelation factor). Multiple regression tests on orthogonalized variables showed that ditch depth is very important. On unfurrowed peatland this factor reduced total variation in the annual mean water table levels from 1 June to 30 September by 26.2%. On furrowed peatland, logarithm of ditch distance, ditch depth and rainfall each accounted for between 15.1 and 17.2% of the variance. Proper drainage for afforestation in northern Norway could be attained by an effective ditch depth of 0.8 m and ditch distances from 9 to 25 m, depending on regional variation in mire types, permeability of surface peat layers and rainfall. On peat with low permeability, furrowing is strongly recommended for afforestation. (Moore-IVI)
W84-04124

DISPERSION SCALE EFFECT IN MODEL CALIBRATIONS AND FIELD TRACER EXPERIMENTS,
Texas A and M Univ., College Station. Dept. of Geology.
For primary bibliographic entry see Field 5B.
W84-04146

COUPLING OF MASS-TRANSFER EQUATIONS AND SOLUTION-SOLID INTERACTION LAWS BY USING LANTHANIDES AS TRACERS - AN EXPERIMENTAL APPROACH (COUPLAGE DES EQUATIONS DE TRANSFERT DE MASSE ET DES LOIS D'INTERACTIONS SOLUTION-SOLID PAR L'UTILISATION DES LANTHANIDES COMME TRACEURS - APPROCHE EXPERIMENTALE),
Paris-6 Univ. (France). Lab. de Geochimie Comparee et Systematique.
S. Bigot, M. Treuil, J. Dumonceau, and F. Fromage.
Journal of Hydrology, Vol. 70, No. 1-4, p 133-148, 1984. 8 Fig, 1 Tab, 18 Ref.

Descriptors: *Groundwater movement, *Tracers, *Lanthanides, Mass transfer, Convection, Dispersion, Lanthanum, Samarium, Europium, Ytterbium, Dysprosium.

In groundwater flow tracing studies, the estimation of the nature and the importance of interactions undergone by the substance used is often an obstacle to good modeling of mass-transfer processes in solution. A method is proposed to quantify these phenomena by the use of lanthanides as tracers. An analytical methodology adapted to routine measurements was set up for this experiment. The lanthanides La, Sm, Eu, Dy and Yb were studied as tracers. A carbonate complex which is extremely stable in the natural environment is formed by substitution. The field experiments carried out demonstrated the efficiency of those tracers and confirmed their greater stability. Convection and dispersion are identical for all the lanthanide elements. A direct relation is established between their fixing rate on earth materials and the value of their stability constants. The possibility of correlative multitracing, with known and quantifiable interelement relations, is demonstrated. (Moore-IVI)
W84-04147

RECHARGE CHARACTERISTICS OF AN UNCONFINED AQUIFER FROM THE RAINFALL-WATER TABLE RELATIONSHIP,
Hunter District Water Board, Newcastle (Australia).
M. N. Viswanathan.
Journal of Hydrology, Vol. 70, No. 1-4, p 233-250, 1984. 6 Fig, 1 Tab, 8 Ref.

Descriptors: *Groundwater recharge, *Rainfall, *Water table aquifers, Water table, Mathematical models, Recursive least squares, Tomago Sandbeds, Newcastle, Australia.

The determination of recharge levels of unconfined aquifers, recharged entirely by rainfall, is done by developing a model for the aquifer that estimates the water-table levels from the history of rainfall observations and past water-table levels. In the present analysis, the model parameters that influence the recharge were not only assumed to be time dependent but also to have varying dependence rates for various parameters. Such a model is solved by the use of a recursive least-squares method. The variable-rate parameter variation is incorporated using a random walk model. From the field tests conducted at Tomago Sandbeds, Newcastle, Australia, it was observed that the assumption of variable rates of time dependency of recharge parameters produced better estimates of water-table levels compared to that with constant-recharge parameters. It was observed that considerable recharge due to rainfall occurred on the very same day of rainfall. The increase in water-table level was insignificant for subsequent days of rainfall. The level of recharge very much depends upon the intensity and history of rainfall. The level of recharge very much depends upon the intensity and history of rainfall. Isolated rainfalls, even of the order of 25 mm/day, had no significant effect on the water-table levels. (Author's abstract)
W84-04153

FREE-SURFACE FLOW IN POROUS MEDIA AND PERIODIC SOLUTION OF THE SHALLOW-FLOW APPROXIMATION,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
J. Y. Parlange, F. Stagnitti, J. L. Starr, and R. D. Braddock.
Journal of Hydrology, Vol. 70, No. 1-4, p 251-263, 1984. 6 Fig, 11 Ref.

Descriptors: *Geohydrology, *Free surfaces, *Groundwater movement, *Porous media, Mathematical equations, Oscillation.

The equations describing the flow of liquid in a porous medium with a free surface are expanded when the shallow-flow assumption holds. Second-order theory is used to describe the propagation of steady periodic motion in the medium, driven by the oscillating level of a reservoir in contact with it. A linearized solution of the second-order theory is compared with a numerical solution and is found adequate even when the amplitude of the motion is comparable to the mean depth of the liquid. The predictions of the analysis are found in good agree-

ment with two laboratory experiments. (Author's abstract)
W84-04154

EFFECTS OF LITHOLOGY ON SOLUTION DEVELOPMENT IN CARBONATE AQUIFERS,
California Univ., Santa Cruz. Dept. of Earth Sciences.
S. J. Dreiss.
Journal of Hydrology, Vol. 70, No. 1-4, p 295-308, 1984. 2 Fig, 5 Tab, 10 Ref. NSF grant GA-20737.

Descriptors: *Karst, *Lithology, *Aquifers, *Carbonate rocks, *Solution features, *Missouri, Groundwater movement, Grain size, Caverns, Bedrock, Magnesium carbonate, Conduits.

In karst aquifers, groundwater flow is extremely difficult to predict because of the presence of solution-enlarged fractures and conduits in the bedrock. The joints act as discrete pathways for rapid groundwater movement. Because the geometry, location and quantity of the conduits are almost always unknown, rates and directions of groundwater movement and contaminant transport cannot be detected reliably with standard monitoring wells nor described adequately with commonly use models. The location and volume of this solution development is the result of interrelated geologic, hydrologic and climatic factors. Rock samples from caverns in southwestern Missouri were analysed for grain size, sorting, percent quartz, percent magnesium carbonate, percent opaque minerals and percent acid-insoluble residue. Cavern morphology is controlled largely by the presence of joints, bedding planes, and laterally extensive chert and shale layers. Within the caves and at cavern entrances, the apparent solution rates of individual bedrock layers as exhibited in the weathered profile are related to the grain size of the bedrock regardless of the bedrock type. Fine-grained layers are less resistant to weathering than coarse-grained layers. In there is appreciable variability in magnesium carbonate content in the bedrock profile, the presence and amount to magnesium carbonate also may influence the apparent solution rate of the bedrock. (Moore-IVI)
W84-04157

HYDRAULICS OF CONDUIT FLOW IN CARBONATE AQUIFERS,
Jesus Coll., Oxford (England).
S. J. Gale.
Journal of Hydrology, Vol. 70, No. 1-4, p 309-327, 1984. 1 Fig, 5 Tab, 54 Ref.

Descriptors: *Conduit flow, *Aquifers, *Carbonate rocks, *Groundwater movement, *Hydraulics, Sediment transport, Karst, Solution features, Erosion, Hydraulic reconstruction.

The movement of groundwater through fissured media, particularly those in which non-Darcian flows prevail, is not well understood. The aquifers with perhaps the greatest proportion of flow along non-Darcian flow lines are probably those composed of limestone, where fissures may be enlarged by solution to form conduits ranging in size from 0.001 to 10 m in diameter. In order to establish the hydraulic conditions under which conduit flows occur, bedform-erosional features and fluid-transported sediments were studied in a variety of carbonate aquifers in different environments. Bedforms developed as the result of solutional erosion in conduits can be classified into two main types: flutes, linear ripple-like features developed transverse to the flow; and scallops, polygonal intersecting depressions. This study is restricted to a consideration of scallops as a means of hydraulic reconstruction. By their nature, caves tend to act as traps for hydraulically transported sediments, which, once deposited, are protected from the erosive effects of many subaerial processes. Such sediments may therefore provide a useful record of hydraulic conditions in groundwater conduits. Mean values of flow velocity, boundary-shear stress, conduit Reynolds number, conduit Froude number, boundary friction factor, boundary roughness and flow power have been calculated. The values obtained are in agreement with other evidence in the conduits and are comparable to those obtained from other, similar, hydraulic systems. (Moore-IVI)
W84-04158

CHANGES IN HYDRAULIC CONDUCTIVITY OF LABORATORY SAND-CLAY MIXTURES CAUSED BY A SEAWATER-FRESHWATER INTERFACE,
Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotope Research.
L. C. Goldenberg, M. Magaritz, A. J. Amiel, and S. Mandel.
Journal of Hydrology, Vol. 70, No. 1-4, p 329-336, 1984. 3 Fig, 2 Tab, 12 Ref.

Descriptors: *Permeability coefficient, *Saline-freshwater interfaces, *Clay, Coastal aquifers, Seawater, Monmorillonite, Illite, Kaolinite.

Information on the hydraulic conductivity in a zone of freshwater-seawater interface is an important factor in the evaluation of coastal aquifers. The sequence of freshwater and seawater flowing through such an aquifer may change its hydraulic conductivity of various sediments. The influence of small amounts of clay minerals on the hydraulic conductivity of sandy aquifer was investigated in the laboratory. Admixture of 1.5% to 10% decreased hydraulic conductivity by one order of magnitude. Montmorillonite caused the strongest decrease; the effect of kaolinite and ilite was only half as large. When seawater was flushed by freshwater, hydraulic conductivity of the montmorillonite-sand mixture decreased drastically. However, flushing with freshwater did not measurably affect the hydraulic conductivity of an ilite-sand or kaolinite-sand mixture. The explanation for this behavior is the capability of various types of clay to adsorb different quantities of water between their platelets which induces a gel-droplet formation process. This is governed by the chemical composition and the ionic strength of the solution. Motion of a seawater-freshwater interface as a result of geological episodes or as a result of water exploration in the region, will create an impermeable layer in an aquifer containing 3-4% of montmorillonite, while the existence of illite or kaolinite will have little influence. Such effects should be considered in analyses of coastal aquifers. (Moore-IVI)
W84-04159

EXPERIMENTAL STUDIES IN NATURAL GROUNDWATER RECHARGE DYNAMICS: ASSESSMENT OF RECENT ADVANCES IN INSTRUMENTATION,
Kansas State Geological Survey, Lawrence.
For primary bibliographic entry see Field 7B.
W84-04162

ROLE OF CAPILLARY WATER ZONE IN GROUNDWATER RECHARGE; OBSERVATION OF RAIN INFILTRATION BY LYSIMETER,
Chiba Univ. (Japan). Dept. of Earth Sciences.
Y. Sakura.
Japanese Journal Limnology, Vol. 44, No. 4, p 311-320, October, 1983. 6 Fig, 2 Tab, 11 Ref.

Descriptors: *Groundwater recharge, *Rainfall infiltration, *Capillary water, Soil water, Outflow, Wetting front, Suspended water zone.

Observations were carried out using a couple of monolith lysimeters with a water table at 145 cm below the ground surface. Measurements of rainfall, outflow and soil water movement were made in order to clarify a mechanism of groundwater recharge caused by a heavy rainfall. The lysimeters were packed with sand 0.38 mm in median grain diameter and Kanto loam originating from volcanic ash soil whose heights of capillary rise are about 45 cm and larger than 125 cm, respectively. Groundwater recharge in the Kanto loam soil begins usually to increase and decrease earlier than in sand. The time required until the beginning of the increase in outflow after the peak of a rainfall intensity is an hour or two in Kanto loam soil, and more than two hours in sand. During the observation period of about one year, outflow from the Kanto loam soil stopped for 34 days and that from the sand for 3 days. These data indicate that groundwater recharge occurs as soon as the wetting front reaches the upper boundary of the capillary water zone, soil water in the suspended water zone is drained slowly and that in the capillary water zone quickly until a water equilibrium is established. (Author's abstract)
W84-04169

ANALYSIS OF LONG-TERM WATER TABLE DEPTH RECORDS FROM A HYDROSEQUENCE OF SOILS IN CENTRAL OHIO,
Ohio State Univ., Columbus. Dept. of Agronomy.
For primary bibliographic entry see Field 2G.
W84-04186

2G. Water In Soils

DEBRIS FLOW HAZARD ASSESSMENT FOR THE OREGON CAVES NATIONAL MONUMENT,
Geological Survey, Portland, OR. Water Resources Div.
J. Friday.
USGS Water Resources Investigations Report 83-4100, 1983. 20 p, 3 Fig, 2 Tab, 24 Ref.

Descriptors: *Debris flows, *Hydrologic hazard, Soil properties, Size distribution, Plasticity, Cave Creek basin, *Oregon, Caves, National Monument, Josephine County.

After experiencing a devastating debris flow in the Oregon Caves National Monument, the National Park Service needs an evaluation of the hazard of additional flows. Soil properties at six random sites were compared with those at the source of the debris flow. Although all sites had soils that could become unstable with sufficient moisture, soil at one site had properties similar to those at the scar and the potential for another flow was confirmed. The report suggests that winter weather conditions be closely monitored and compared to the antecedent conditions prior to the known failure. When the threshold for additional mass wasting is believed imminent, appropriate action can be taken to insure the safety of work personnel and the public. The peak streamflow that preceded the 5,200 cu yds of debris is estimated to have a 0.5 percent chance of being equaled or exceeded in any given year. (USGS)
W84-03577

GUIDE TO GEOLOGIC AND HYDROLOGIC IDENTIFICATION OF FRESHWATER WETLANDS ON THE TUG HILL PLATEAU, NEW YORK,
Syracuse Univ., NY. Dept. of Geology.
For primary bibliographic entry see Field 2A.
W84-03655

VIRUS MOVEMENT IN SOIL DURING SATURATED AND UNSATURATED FLOW,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
For primary bibliographic entry see Field 5B.
W84-03703

DETERMINATION OF CAPILLARY HYDRAULIC CONDUCTIVITY OF SOILS AND ITS DEPENDENCE ON SUCTION,
Institut Fotosinteza, Pushchino (USSR).
Ya. A. Pachepsky, and R. A. Scherbakov.
Journal of Hydrology, Vol. 69, No. 1-4, p 287-296, February, 1984. 4 Fig, 27 Ref.

Descriptors: *Hydraulic conductivity, *Capillary conductivity, *Soil properties, Soil water suction, Soil water, Mathematical studies, Mathematical equations.

The relationship between hydraulic conductivity and suction as well as the suction-moisture dependence are the most important hydrophysical soil characteristics. Recently successful predictions of water-content redistribution have been made on

the basis of such functions. A new method using joint data on moisture and suction changes is proposed and verified. The method is based on the derivation of a specific integral analogue of the capillary moisture transport equation. No artificial water regime is required; derivation of tabulated functions is avoided. The method, therefore, may be used to find the k(psi) relation from field data. (Murphy-IVI)
W84-03788

CHARACTERIZING PONDED INFILTRATION IN A DRY CRACKED CLAY SOIL,
Stichting voor Bodemkartering, Wageningen (Netherlands). Dept. of Applied Soil Physics.
J. Bouma, and J. H. M. Wosten.
Journal of Hydrology, Vol. 69, No. 1-4, p 297-304, February 1984. 3 Fig, 2 Tab, 9 Ref.

Descriptors: *Infiltration, *Dry soil, *Clay soil, Ponded infiltration, Infiltration rate, Soil cracks, Cracks, Soil water, Mathematical analysis.

Infiltration and redistribution of water in dry cracked clay soil is difficult to characterize. A comprehensive simulation model for predictive purposes has, as yet, not been developed because of lack of understanding of the complex processes involved. Ponded infiltration in a dry cracked clay soil was studied in large blocks of soil (upper surface area 1500 sq cm, height 25-40 cm) using physical and morphological methods. Blocks were encased in gypsum. Physical measurements included: infiltration rates into the block and into subsoil below the block during shallow ponding; D-theta relations of soil in the block; and depth and degree of wetting in soil adjacent to the cracks. Cracks in the block were then filled with a gypsum slurry. Morphological measurements included Quantimet counts of the surface area (A) and the peripheral length (L) of the gypsum-filled cracks, using in situ drawings. Simulation of horizontal infiltration from the cracks, using D(theta)- and L-values, yielded results that agreed well with in situ measurements, demonstrating the mutual compatibility of the morphological and physical methods. (Murphy-IVI)
W84-03789

PODZOLIZATION: SOIL PROCESSES CONTROL DISSOLVED ORGANIC CARBON CONCENTRATIONS IN STREAM WATER,
Cornell Univ., Ithaca, NY.
W. H. McDowell, and T. Wood.
Soil Science, Vol. 137, No. 1, p 23-32, January, 1984. 5 Fig, 3 Tab, 30 Ref.

Descriptors: *Dissolved solids, *Podzols, Soil types, Podzolization, Streams, New Hampshire, Spodosol, Lysimeters, Hubbard Brook.

Dissolved organic carbon (DOC) was measured in soil solutions collected from the A and B horizons of a Spodosol in central New Hampshire. DOC averaged 33 mg/L in the A2 horizon and declined to 2 to 3 mg/L in the B horizon. DOC concentrations in A2 horizon lysimeters were inversely related to the volume of water collected per day. Maximum concentrations of about 55 mg/L were observed during September. In the B horizon lysimeters, DOC levels were relatively constant, as were levels in stream water. In lab experiments, DOC in A2 horizon soil solution was rapidly absorbed by B horizon soils. The equilibrium DOC concentrations predicted by adsorption isotherms agreed to within 1 to 2 mg/L with lysimeter results. Coprecipitation of iron and organic matter in the upper B horizon, a process central to podzolization, largely controls the concentration of dissolved organic carbon in stream water at Hubbard Brook. (Baker-IVI)
W84-03800

EFFECTS OF SOIL WATER CONTENT ON PENDIMETHALIN DISSIPATION,
Agricultural Research Service, Akron, CO. Central Great Plains Research Station.
M. R. Barrett, and T. L. Lavy.
Journal of Environmental Quality, Vol. 12, No. 4, p 504-508, 1983. 2 Fig, 2 Tab, 18 Ref. OWRT project B-057-ARK.

Descriptors: *Soil water, *Pendimethalin, Environmental effects, Herbicides, Herbicide dissipation, Aerobic soils, Anaerobic soils, Soil properties.

Studies on herbicide dissipation, which isolate one or two environmental effects at various levels, fail to provide needed information on the interactions. Laboratory and field studies were conducted to evaluate pendimethalin, N-(1-thylpropyl)-3,4-dimethyl-2,6-dinitroaniline, dissipation over time in a Crowley silt loam (Typic Albaqualfs). In the laboratory, dissipation rates approximately followed pseudo first-order kinetics over a 56-d period, except in air-dried soil that had no significant loss of pendimethalin detected after 56 d. Half-lives for 30 kPa, continuous flood, and alternately flooded and dried treatments averaged 59, 63, and 30 d, respectively, under laboratory conditions. Application rates of 0.5, 1.0, and 2.0 microg/g of soil did not have a significant influence on the half-lives. The ratio of pendimethalin residues in laboratory systems detected by a root bioassay with grain sorghum (Sorghum bicolor (L.) Moench.) to those detected with gas-liquid chromatography (GLC) declined by 17% from 0 to 56 d after treatment. Dissipation in the field in each of 2 y was studied with lowland rice (Oryza sativa L.) (flush irrigated then flooded 2-3 weeks after application), upland rice (flush irrigated throughout the season), and soybean (Glycine max (L.) Merr.) (furrow irrigated as needed) management systems. Soil water content had a strong influence on the amount of pendimethalin that dissipated, especially for about the first 2 weeks after herbicide application. Half-lives in the field were much shorter during the initial 2 weeks than after 2 weeks, with > 50% of the applied herbicide having disappeared in 1 week for all treatments except in soybeans the first year. Soil persistence of pendimethalin was greater under soybean culture (soil-incorporated herbicide, low-irrigation frequency) than under rice culture (surface-applied herbicide, high irrigation frequency, and/or flooded conditions). (Murphy-IVI)
W84-03928

SELECTED EFFECTS OF FIELD VARIABILITY ON PREDICTIONS FROM A SOIL WATER FINITE DIFFERENCE MODEL,
Bristol Univ. (England). Dept. of Geography.
M. G. Anderson.
Nordic Hydrology, Vol. 14, No. 1, p 1-18, 1983. 15 Fig, 2 Tab, 33 Ref.

Descriptors: *Soil water, *Model studies, Prediction, Catchment areas, Stochastic processes, Surface water, Surface runoff, Finite difference.

Finite difference schemes employing various levels of resolution of space and time are commonly employed to predict soil water conditions. Selected effects of known parameter variability upon the predictive capacity of a finite difference scheme were investigated. The resolution of predictions obtained was relatively robust against within-soil-group changes in the soil water retention characteristics. A significant deterioration in resolution occurred when all input parameters were subjected to stochastic sampling from specified distributions. Even so, under these relaxed conditions, spatial probability fields of relative saturation exceedence retained good resolution. Runoff predictions exhibit low variation generally, and accord well with the SCS curve prediction method, suggesting the possibiliy of using finite difference schemes incorporating field variability for ungauged catchment modelling. (Baker-IVI)
W84-03972

EFFECT OF SLASH BURNING ON THE WATER REPELLENCY OF FOREST SOILS AT VANCOUVER, BRITISH COLUMBIA,
Pacific Forest Research Centre, Victoria (British Columbia).
G. S. Henderson, and D. L. Golding.
Canadian Journal of Forest Research, Vol. 13, No. 2, p 353-355, April, 1983. 2 Tab, 8 Ref.

Descriptors: *Water repellent soils, *Slash burning, *Forest soils, *Vancouver, *British Columbia, Clear-cutting, Forest management, Humus.

Soil from 10 slash burned and 3 unburned clear-cuts was tested for water repellency by the water drop penetration method and compared with naturally occurring soil water repellency in uncut mature forest. There was no difference in soil water repellency between unburned clear-cuts and the uncut forest control. Soil was more frequently water repellent in slash burned sites (35% of samples) than in the control sites (21% of samples), but differences were significant only for the first 2 years after burning. All humus samples were severely water repellent. At the 0- to 4-cm depth below the humus, burned samples were more frequently repellent than control samples, but there was no difference at the 8- to 10-cm and 15+ cm depths. Water repellence decreased with depth in both burned and control sites. (Author's abstract)
W84-04122

WATER ABSORPTION OF XEROMOR FOREST FLOOR SAMPLES,
Nicolas Copernicus Univ. of Torun (Poland). Dept. of Soil Science.
A. Grelewicz, and W. Plichta.
Forest Ecology and Management, Vol. 6, No. 1, p 1-12, June, 1983. 5 Fig, 12 Ref.

Descriptors: *Forest soils, *Soil water, *Adsorption, Humus, Litter, Organic matter.

Samples from the xeromor type humus horizon with different initial water contents were irrigated and the water adsorption studied. Four samples were used: from the litter (AoL), fermentation (AoF) and epihumus (AoFH) subhorizons and from the humus-mineral horizon (Ah). The samples were sprinkled continuously under laboratory conditions with an intensity of 10 mm/h. Irrigated samples with low initial moisture contents showed the lowest rate of water adsorption, whereas in those with highest initial moisture content a quick increase in water content was observed. Two phases were distinguished: that of total adsorption of irrigated water and that of partial adsorption and outflow. The duration of the first phase was about 10 min for the samples with the lowest initial moisture content and about two hours for samples with higher initial moisture content. Significant differences in the first phase of water adsorption were connected with the degree of humification. When the humification degree increases, so do the differences in absorption properties of the organic material due to initial moisture content. The ratios of water content was 01.82, 0.36 and 0.47, respectively. This shows that the initial water content has the least effect on the first phase of water adsorption in the least humified material from subhorizon AoL. The water properties of the organic horizon significantly affect adsorption by the forest floor. (Author's abstract)
W84-04127

SOIL THERMAL AND MOISTURE REGIMES ON FORESTED SLOPES OF AN APPALACHIAN WATERSHED,
West Virginia Univ., Morgantown. Div. of Forestry.
J. A. Werling, Jr., and S. J. Tajchman.
Forest Ecology and Management, Vol. 7, No. 4, p 297-310, February, 1984. 6 Fig, 3 Tab, 24 Ref.

Descriptors: *Soil temperature, *Soil water, *Forest soils, *Appalachians, Aspect, Seasonal variation, Slopes.

Soil thermal and moisture regimes were studied at four sites of contrasting slope positions and aspects within a forested Appalachian watershed (39 degrees 41' N, 79 degrees 45' W, elevation from 567 m to 796 m). The overall mean temperatures for the 0-50 cm soil layer was 12.3 C in 1981; mean annual temperatures ranged from 13.3 C at 2 cm depth on a south-facing lower site to 11.0 C at 50 cm depth on a north-facing lower site. During the growing season soil temperatures of the south-facing lower site exceeded those of other sites by 1 C or less for soils less than 20 cm in depth. Maximum temperature differences between sites were reached in November, and the minimum temperature differences between sites were observed in

January. The soil moisture content on the north-facing site exceeded that of all other sites. The south-facing lower site was the driest, while the south-facing upper site and the ridge top were intermediate and had similar moisture regimes. It was concluded that the moisture regime of the south-facing lower site was a joined effect of aspect and relatively high stoniness. (Author's abstract)
W84-04129

SMALL-SCALE HETEROGENEITY AND SOIL-MOISTURE VARIABILITY IN THE UNSATURATED ZONE,
Toronto Univ. (Ontario). Dept. of Geography.
A. G. Price, and B. O. Bauer.
Journal of Hydrology, Vol. 70, No. 1-4, p 277-293, 1984. 9 Fig, 1 Tab, 30 Ref.

Descriptors: *Aeration zone, *Soil water, *Soil texture, Percolation, Soil hydraulics.

Soil moisture content was measured at seven location within the unsaturated zone of an instrumented swale using a subsurface moisture probe with a gauge scalar. The bulk of the data is from a 5 m long transect of five access tubes. Readings were taken at 0.1 m depth intervals starting at 0.2 m and extending to 2.3 m below the ground surface. Great variability in soil-water content exists in a soil mass of only 5.0-m length and 2.5-m depth. Surface-water inputs from snowmelt and runoff are spatially homogeneous throughout the basin, but interact with heterogenous soil to generate great complexity. Water which initially percolates vertically is differentially impeded as a result of subtle textural changes in the soil, and is then preferentially retained in such zones of transition, causing large differences in soil-water content to occur. The scale of this vertical variability is of tenths of meters, while lateral variability of soil moisture reflects textural changes over a few meters. The observed influence of small-scale heterogeneity on soil-water content suggests that the conventional assumptions of isotropicity and homogeneity of the textural and hydraulic properties of porous media used in drainage basin and hillslope hydrological models need scrutiny, even for single stratigraphic units. (Moore-IVI)
W84-04156

SOIL AND XYLEM WATER POTENTIAL AND SOIL WATER CONTENT IN CONTRASTING PINUS CONTORTA ECOSYSTEMS, SOUTHEASTERN WYOMING, USA,
Wyoming Univ., Laramie. Dept. of Botany.
For primary bibliographic entry see Field 2I.
W84-04175

SUBMERSIBLE PRESSURE OUTFLOW CELL FOR MEASUREMENT OF SOIL WATER RETENTION AND DIFFUSIVITY FROM 5 TO 95 DEGREES C,
Geological Survey, Menlo Park, CA.
J. Constantz, and W. N. Herkelrath.
Soil Science Society of America Journal, Vol. 48, No. 1, p 7-10, January-February, 1984. 3 Fig, 10 Ref.

Descriptors: *Pressure outflow cell, *Soil moisture retention, *Soil temperature, Soil water diffusivity, Hysteresis, Moisture content.

A technique was developed to measure water content in soil as a function of capillary pressure from 5 to 95 degrees C. To overcome problems encountered at high temperature, a modified Tempe pressure cell containing a soil sample is suspended in a constant-temperature water bath. The cell's porous plate is in direct contact with circulating bath water, thus eliminating the problem of entrapped air bubbles. A balance located above the water bath measures water content changes in the soil by weighing the entire pressure cell under water. The technique is designed to measure soil water retention characteristics and to make transient outflow estimates of the soil water diffusivity at temperatures from 5 to 95 degrees C. The technique was also used to determine the isobaric temperature dependence of water retention in soil. Results indicate that at constant capillary pressure, the relationship between moisture content and temperature is hysteretic. (Murphy-IVI)
W84-04180

SHAPE FACTORS FOR SEEPAGE INTO PITS,
Illinois Univ. at Urbana-Champaign. Agricultural Experiment Station.
C. W. Boast, and R. G. Langebartel.
Soil Science Society of America Journal, Vol. 48, No. 1, p 10-15, January-February, 1984. 3 Fig, 1 Tab, 17 Ref. Illinois Agric. Exp. Stn. project 15-0356.

Descriptors: *Shape factors, *Seepage, Seepage pits, Hydraulic conductivity, Water table, Auger hole, Soil water.

The Auger Hole method for measuring hydraulic conductivity of soil below a water table has generally been used with relatively thin auger holes. For cerain situations, however, especially for stony soils, the practicality of using broad, shallow pits has been explored. This technique is called the 'pit-bailing' method. In the field 'pit-bailing' method, saturated hydraulic conductivity below a water table is determined from the rate of rise of water in a pit. The relationship between the rate of rise and the soil hydraulic conductivity is expressed as a shape factor. Shape factors are presented here for pits with length/radius ratio ranging from 0 to 2, for pits ranging from empty to 0.9 full, and for impermeable-barrier and very permeable source lower boundary conditions at various distances below the pit. The calculated shape factors are extrapolated to the situation of a pit in an effectively infinitely deep uniform soil. Shape factors for pits of a given fullness with a source or a semi-infinite lower boundary condition are found to decrease and then increase as the length/radius ratio of the bit increases, reaching a minimum typically when this ratio is between 0.2 and 0.5 for the semi-infinite case. This trend is investigated to determine whether it is due to calculation errors for extreme geometries or is due to real phenomena. That the trend exists is found by examining analytical solutions to two situations - a pit fully penetrating to an impermeable barrier and a disk in semi-infinite space. (Murphy-IVI)
W84-04181

STATISTICAL ANALYSIS OF SALINITY AND TEXTURE EFFECTS ON SPATIAL VARIABILITY OF SOIL HYDRAULIC CONDUCTIVITY,
Agricultural Research Organization, Bet-Dagan (Israel). Div. of Soil Physics.
E. Bresler, G. Dagan, R. J. Wagenet, and A. Laufer.
Soil Science Society of America Journal, Vol. 48, No. 1, p 16-25, January-February, 1984. 3 Fig, 6 Tab, 27 Ref.

Descriptors: *Soil hydraulic conductivity, *Salinity, *Soil texture, Statistical analysis, Soil properties, Hydraulic conductivity, Soil saturation, Saline soils, Semivariogram, Covariogram, Multiple regression.

Managing water to optimize crop production is dependent on soil properties that affect the ability of the soil to trasmit water and salts. A statistical analysis that identifies the dominant factors responsible for the spatial variability of the saturated conductivity (Ks) in a selected field is presented. The variables are considered random functions of the space coordinates. Two types of stationarity are investigated: a constant mean and stationary variogram (stationarity of order 2) and trend of the means (nonstationarity of the mathematical expectation) with stationary covariances. Linear models of statistical dependence were used. Elimination of factors of minor importance was based on correlation analysis. Electrical conductivity (EC) and percent sand were the most important independent variables, whereas Ks, was the dependent variable. The analysis showed that soil salinity (EC) accounted for only 10 to 15% of the variability of Ks, texture (percent sand) explained 25 to 45% of the Ks variability, and 10 to 15% of the variability was explained by the interaction between salinity and texture. Various soil factors other than salinity and texture accounted for 30 to 50% of the variability in Ks. Semivariograms and covariograms of KsEC, and percent sand did not have a sill because of a significant horizontal linear trend. Calculations showed that the trend accounted for a about a half of the variability of the original data. Semivariograms and covarigrams of a new population of residuals after extracting the trend gave values of the sills equal to the variances. The integral scale of the residuals of Ks and percent sand was estimated to be about 15 to 20 m, whereas salinity (EC) did not display a spatial structure. The results can be generalized for other studies with different values of variances and covariances of soil salinity and soil texture. (Murphy-IVI)
W84-04182

ENHANCEMENT OF THERMAL WATER VAPOR DIFFUSION IN SOIL,
Washington State Univ., Pullman. Dept. of Agronomy and Soils.
A. Cass, G. S. Campbell, and T. L. Jones.
Soil Science Society of America Journal, Vol. 48, No. 1, p 25-32, January-February, 1984. 5 Fig, 3 Tab, 31 Ref. Dept. of Energy contract DE-AC06-76RL0 1830.

Descriptors: *Water vapor diffusion, *Water vapor, Temperature gradient, Thermal conductivity, Model studies, Evapotranspiration, Soil water, Soil properties, Soil Temperature, Moisture content, Mechanistic enhancement factor, Phenomenological enhancement factor, Nonisothermal diffusion.

Theories based on 'simple' adaptations of Fick's Law of diffusion do not adequately describe thermally induced flow except for extremely dry soils. An accurate description of thermally induced water vapor flow is needed to understand flow processes associated with evaporation from bare soil, groundwater recharge in the presence of deep geothermal gradients and heat loss from shallow aquifers used to store thermal energy. The enhancement of water vapor diffusion in soil resulting from a temperature gradient was determined using a transient state thermal conductivity measurement. A method was adapted for this study to allow measurement of the thermal conductivity as a function of temperature, water content, and pressure. The data allowed separation of thermal conductivity from thermally induced latent heat transport. Both the mechanistic enhancement factor eta of Philip and de Vries and the phenomenological enhancement factor beta of Cary are calculated from the slope of the relationship between thermal conductivity and reciprocal relative pressure. The enhancement factor, eta approaches 1 for dry soil and increases rapidly to values around 10 for a sand and a silt loam at water contents above half saturation and temperatures about 22 degrees C. At high water content and 3.5 degrees C, eta increased to 15. The inflection point water content for the eta vs. saturation curve was about twice as high in silt loam as in sand. Measurements conform well to the pattern predicted by a theoretical examination of enhancement factor behavior. Experimental results were also compared with two recent quantitative models of beta. These model predictions did not agree with measured values, nor did they conform to the theoretical limits of beta derived in this paper except at intermediate saturation and temperature values. (Murphy-IVI)
W84-04183

EFFECT OF PH ON SATURATED HYDRAULIC CONDUCTIVITY AND SOIL DISPERSION,
Agricultural Research Service, Riverside, CA. Salinity Lab.
D. L. Suarez, J. D. Rhoades, R. Lavado, and C. M. Grieve.
Soil Science Society of America Journal, Vol. 48, No. 1, p 50-55, January-February, 1984. 4 Fig, 2 Tab, 20 Ref.

Descriptors: *Hydrogen ion concentration, *Hydraulic conductivity, *Soil dispersion, Soil saturation, Soil water, Soil dispersants, Sodium adsorption rate, Electrolytes.

The adverse effects of exchangeable sodium on soil hydraulic conductivity (K) are well known, but at present only sodicity and total electrolyte concentration are used in evaluating irrigation water suitability. In arid areas, high sodicity is often associated with high dissolved carbonate and thus high pH, but in human areas high sodicity may be associated with low pH. To evaluate the effect of pH (as an indepedent variable) on K, solutions with the same SAR and electrolyte level were prepared at pH 6, 7, 8, and 9. Saturated K values were determined at constant flux in columns packed at a bulk density of 1.5 Mg cu m. At pH 9, saturated K values were lower than at pH 6 for a montmorillonitic and a kaolinitic soil. For a vermiculitic soil with lower organic carbon and higher silt content, pH changes did not cause large K differences. Decreases in K were not reversible on application of waters with higher electrolyte levels. The results from the K experiments were generally consistent with optical transmission measurements of dispersion. Although anion adsorption was at or below detection limits and cation exchange capacity (CEC) was only slightly dependent on pH, differences in pH effects on K among soils are likely due to differences in quantities of variable-charge minerals are organic matter. (Author's abstract)
W84-04184

DIVISION S-5-SOIL GENESIS, MORPHOLOGY, AND CLASSIFICATION, MOISTURE REGIMES AND MORPHOLOGICAL CHARACTERISTICS IN A HYDROSEQUENCE IN CENTRAL MASSACHUSETTS,
Massachusetts Univ., Amherst. Dept. of Plant and Soil Sciences.
E. W. Pickering, and P. L. M. Veneman.
Soil Science Society of America Journal, Vol. 48, No. 1, p 113-118, January-February, 1984. 4 Fig, 25 Ref.

Descriptors: *Soil mottling, *Soil classification, Soil saturation, Soil water, Soil properties, Soil temperature, Soil water table, Water table, Water table fluctuations.

Characterization of mottling phenomena frequently is a requisite for soil classification and soil survey interpretation. The absence, presence, and nature of mottles have become a key morphological feature for the inference of soil drainage conditions as it is often impractical to measure the soil moisture regime directly through long-term monitoring. Moisture regimes and associated soil mottling patterns were investigated over a 2-yr period in a Paxton-Ridgebury-Scarboro hydrosequence in central Massachusetts. Changes in physical conditions in these coarse-loamy fragipan soils were monitored with well points, tensiometers, soil temperature probes, and redox potential electrodes. Well-drained soils appeared uniformly brown, reflective of a generally strongly oxidized environment. They also showed the greatest seasonal fluctuations in soil temperature ranging from 0 to 23 degrees C. Matrix colors of highest chromas (6 or higher) occurred in the moderately well-drained (MWD) soils where reducing and oxidizing environments coexist within the profile at some time during the growing season. Prominent ferrans and albans in the 2Cx horizons of MWD soils were related to sustained groundwater levels, although higher water tables often occurred for periods too short or too cold for development of strongly reducing conditions. The characteristics grey streaking patterns of fragipans were best expressed in the 2Cx horizons of MWD soils and can be attributed to reducing environments during periods with soil temperature above biologic zero when conditions are wet but unsaturated. Significant translocation and leaching of iron occurred in the somewhat poorly drained soils, as evidenced by olive-grey matrix colors. Channel neoferrans and some neoalbans indicated that a reducing environment may persist within the B2 horizon long after it has become unsaturated. Lowest chroma colors in this hydrosequence was found in the very poorly drained soils where perennial conditions of saturation or near saturation exists up to the soil surface resulting in the strongest reducing environment and least fluctations in seasonal temperatures. (Murphy-IVI)
W84-04185

ANALYSIS OF LONG-TERM WATER TABLE DEPTH RECORDS FROM A HYDROSEQUENCE OF SOILS IN CENTRAL OHIO,
Ohio State Univ., Columbus. Dept. of Agronomy.
T. M. Zobeck, and A. Ritchie, Jr.
Soil Science Society of American Journal, Vol. 48, No. 1, p 119-125, January-February, 1984. 5 Fig, 2 Tab, 21 Ref.

Descriptors: *Water table depth, *Soil water table, Groundwater, Groundwater level, Drainage, Ohio.

Water table depth is a dynamic soil feature that fluctuates greatly from year to year and throughout the year when measured in the same soil series as well as between soils of different series. Water table depths and precipitation were measured over a 10-yr period on four adjacent forested soils in central Ohio. The soils included a hydrosequence of well, moderately well, poorly, and very poorly drained fine-textured soils. Graphs describing the probability of observing water tables during consecutive 2-week (semi-monthly) intervals, by soil depth class, were compared with estimates reported on USDA-Soil Conservation Service forms SOIL-SOI-5 and a method proposed in the Soil Survey Manual. All soils had a probability of an observed water table within 50 cm of the soil surface. Water tables were observed in all soils, with the exception of the well drained soil, within 25 cm of the surface, 10% of the time or more, over a 12- or 14-week period in the late winter and spring. (Murphy-IVI)
W84-04186

2H. Lakes

LIMNOLOGICAL STUDIES IN LAKE VILLARRICA, MORPHOMETRIC, PHYSICAL, CHEMICAL, PLANKTONICAL FACTORS AND PRIMARY PRODUCTIVITY,
Universidad Austral de Chile, Valdivia.
H. Campos, W. Steffen, C. Roman, L. Zuniga, and G. Aguero.
Archiv fur Hydrobiologie, Suppl. 65, No. 4, p 371-406, December, 1983. 15 Fig, 5 Tab, 40 Ref.

Descriptors: *Oligotrophic lakes, *Limnology, *Lake Villarrica, *Chile, Chemical analysis, Plankton, Primary productivity, Physical properties, Morphometry, Phytoplankton, Trancura River, Nutrients, Seasonal variation.

Lake Villarrica is located in a pre-andean mountain range at 230 m above sea level. The lake is oligotrophic, monomictic, and temperate with winter circulation and summer stratification. Its main physical and chemical parameters were studied during a year. The same data were simultaneously obtained in its principal affluent, the Trancura river, which is an important supplier of nutrients to the lake. The phytoplankton was analyzed qualitatively and quantitatively with its seasonal variations in the water column. The diatoms are dominant in autumn-winter, and the Myxophyceae and Chlorophyceae in spring-summer. The pattern of annual variation of phytoplanktonic density coincides with that of chlorophyll-a and primary productivity. The maximum productivity was registered in summer. The zooplankton was analyzed qualitatively and quantitatively with its seasonal variations that follow the pattern of the phytoplankton density. Lake Villarrica seems to maintain its oligotrophy because of its morphometric constitution, seasonal variation regulated mainly by the temperature, limited input of nutrients from its affluents, seasonal phytoplankton variation with different communities (spring and summer) responsible for the greater productivity, and variation of the zooplankton density according to the phytoplankton density. (Baker-IVI)
W84-03505

ARE CHANGES IN PHYTOPLANKTON ASSEMBLAGES OF PIBURGER SEE CONSEQUENCES OF HYPOLIMNETIC WATER REMOVAL (SIND DIE VERANDERUNGEN IM PHYTOPLANKTONBILD DES PIBURGER SEES AUSWIRKUNGEN DER TIEFENWASSERABLEITUNG),
Innsbruck Univ. (Austria). Botanisches Inst.
For primary bibliographic entry see Field 5G.
W84-03507

TEMPORAL VARIATION IN ALGAL BIOASSAYS OF WATER FROM TWO PRODUCTIVE LAKES,
Freshwater Biological Association, Windermere (England).
J. D. Box.
Archiv fur Hydrobiologie, Suppl. 67, No. 1, p 81-103, October, 1983. 6 Fig, 3 Tab, 59 Ref.

Descriptors: *Algal growth, *Bioassay, *Phosphorus, Dissolved organic matter, Iron, Microcystis, Blelham Tarn, Esthwaite Water, England.

Results of laboratory bioassays using Microcystis aeruginosa (Cyanophyta) carried out over a year on GF/C filtered water-samples from two productive lakes (Blelham Tarn and Esthwaite Water) in the English Lake District are presented. It was necessary to add EDTA or Fe(III)EDTA to demonstrate the phosphorus limitation which had been predicted from N:P ratios (atomic). The increased yield obtained at all times with added EDTA or FeEDTA suggested that iron was of major importance to the growth of the test alga. Unenriched and nutrient enriched water samples taken from both lakes during winter showed very low yields which may have been caused by the effects of trace metals. The ability of the water-samples from both lakes to support growth of the test alga was restored during the spring and a maximum yield was obtained during the summer when the ambient nutrient levels were low. It was not possible to separate the effects which the spring and summer phytoplankton populations could have had on the test alga - for instance, the stimulatory effect of the raised pH or the possible effects of the increased levels of dissolved organic material. (Baker-IVI)
W84-03508

BENTHIC ALGAE OF THE DANUBE IN THE NEIGHBOURHOOD OF VIENNA (DIE BENTHISCHEN ALGEN DER DONAU IM RAUM VON WIEN),
Biological Station, Lunz am See (Austria).
E. Kann.
Archiv fur Hydrobiologie, Suppl. 68, No. 1, p 15-36, October 1983. 3 Tab, 73 Ref.

Descriptors: *Benthos, *Algae, *Danube River, Vienna, Austria, Water pollution effects, Wastewater.

The benthic algal biocoenosis (except diatoms) of the Danube to be found on embankment boulders, boats, pontoons and plants in the area of Vienna are described, with special reference to the influences of ecological factors, particularly sewage. The embankment boulders of the Danube are conspicuously green, owing mainly to epilithic chlorophytes, especially Cladophora. Diatoms are numerous. Often these algae are covered by detritus and then their development is hampered. On boats and pontoons there is a green belt of near-surface living algae such as Ulothrix, Cladophora and others. As epiphytes on algae and mosses, Chamaesiphon incrustans and diatoms prevail. The influences of the combined ecological factors are not clear in every case. The chemical factors and pH cause an algal flora known partially also from limestone streams. Influence of temperature or current could not be found. A zonation of the flora by the different water levels (high and low water) is not conspicuous. Light gradients are important on the lateral faces of stones. Sewage-pipe inflows are marked by tufts of Sphaerotilus and by an increase of green algae, especially Cladophora. Because of the broad ecological valence of the algae, it is not possible to classify them into distinct saprobity levels. Compared with other parts of the Danube some common species are found among the filamentous green algae and certain blue-green algae; but there are also important differences. (Baker-IVI)
W84-03510

ECOLOGICAL STUDIES ON THE PERIPHYTON PRODUCTIVITY IN THE RIVER LOISACH (PRODUKTIONSBIOLOGISCHE UNTERSUCHUNGEN AN DER LOISACH ANHAND VON AUFWUCHSMESSUNGEN),
Bayerisches Landesamt fuer Wasserwirtschaft, Munich (Germany, F.R.).
B. Wachs.
Archiv fur Hydrobiologie, Suppl. 68, No. 1, p 77-99, October, 1983. 12 Fig, 7 Tab, 12 Ref.

Descriptors: *River Loisach, *Aquatic productivity, *Periphyton, River Isar, Lake Kochel, West Germany, Nutrients, Light intensity, Flow rate, Diatoms.

Periphyton was monitored regularly from 1979 to 1981 at three stations in the middle region of the River Loisach. The dominant periphyton species were identified: certain diatoms, Hydrurus foetidus, green and blue algae. A comparison of the averaged biomass with ecological conditions shows that in the outflow from the lake, production is two to three times greater than that in the river immediately above the lake. This maximum development of the periphyton biocoenosis is due to the high frequency of diatoms as well as to the stronger growth of the alga Hydrurus foetidus in the outflow. A clear seasonal preference was shown by the major species. The higher productivity in the lake outflow and the high fluctuations in the periphyton mass of this river region in contrast to those of the inflow are due mainly to physical factors, as the water of this river system is not below class II in quality. The most important ecofactors controlling periphyton development in the Loisach are the intensity of light and the rate of flow. (Baker-IVI)
W84-03512

ECOLOGICAL CHARACTERISTICS OF LAKES IN NORTH-EASTERN POLAND VERSUS THEIR TROPHIC GRADIENT; I. GENERAL CHARACTERISTICS OF 42 LAKES AND THEIR PHOSPHOROUS LOAD. STUDY OBJECTIVES AND SCOPE,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
Z. Kajak, and B. Zdanowski.
Ekologia Polska, Vol. 31, No. 2, p 239-256, 1983. 3 Tab, 27 Ref.

Descriptors: *Lakes, *Eutrophication, *Phosphorus, *Poland, Drainage basins, Dimictic lakes, Polymictic lakes, Trophic level, Ecosystems, Water pollution sources.

General information is provided on complex studies conducted on 42 lakes (23 dimictic and 19 polymictic lakes) which are representatives for the lakelands in north-eastern Poland. The main objective was the characteristic of trophic state and the purity of lakes and a quantitative analysis of the main ecosystem components as a basis for determining characteristics and indices for lakes of various trophic state; the functioning of lake ecosystems depending on trophic state, pollution, and degree of mixing; and the rate of trophic state changes by comparing with data from other periods. At the study site sandy-loamy soils of an average permeability dominated. On the basis of the surface area of the drainage basin, the type of soil utilization, and the data on the amount and kind of sewage, and data on phosphorus export from land, the phosphorus load to lakes was estimated. Phosphorus load and also total phosphorus and nitrogen concentration in epilimnion in summer correlated positively with the density of river net in the drainage basin and with the ratio of surface area of the drainage basin to the surface area and volume of the lake. In 28 lakes also examined 15-29 years ago the visibility decreased, mainly in dimictic lakes. In some lakes the oxygen deficits in the hypolimnion were greater. The greater percent of dimictic lakes, where changes were observed as compared with the state some years ago, was undoubtedly due to the fact that the trophic status of these lakes was and is lower on the average than that of polymictic lakes, and thus more sensitive to the increasing load and concentration of nutrients. (Baker-IVI)
W84-03516

ECOLOGICAL CHARACTERISTICS OF LAKES IN NORTH-EASTERN POLAND VERSUS THEIR TROPHIC GRADIENT; II. LAKE CATCHMENT AREAS - PHYSICO-GEOGRAPHICAL ENVIRONMENT. DESCRIPTION OF THE REGION AND 43 LAKES,
Warsaw Univ. (Poland). Inst. of Physical Geographic Sciences.
E. Bajkiewicz-Grabowska.
Ekologia Polska, Vol. 31, No. 2, p 257-286, 1983. 1 Fig, 8 Tab, 13 Ref.

Descriptors: *Lakes, *Limnology, *Poland, Nutrients, Precipitation, Lithology, Catchment areas, Climates, Drainage areas, Water pollution prevention, Soil, Land use, Geography.

A lake drainage area located in north-eastern Poland, mainly in the Masurian Lake District, was used to assess the effect of physico-geographical parameters on the removal and supply of nutrient matter to lakes. The annual precipitation totals range from 500 to 600 mm in this area of Poland, and only in the morainic-hill zone do they reach 600-700 mm. In assessing the effect of the catchment areas on the potential of nutrient matter supply to the lake several physico-geographical parameters of the catchment area were taken into account. These included some morphometric parameters such as the size of the catchment area directly included in the outflow, the average gradient of the catchment area, the river-network density, as well as the lithology, soil type and land use. Parameters relating the catchment area size to the size of the water body itself and to its water volume were also considered. The aggregate total of the characteristics made it possible to group the catchment areas into four classes which differ in their possibilities of removing matter, and in their rate of its supply to the water body. The classification indicates the parameters which to a medium and high degree affect the potential of nutrient matter supply. (Baker-IVI)
W84-03517

ECOLOGICAL CHARACTERISTICS OF LAKES IN NORTH-EASTERN POLAND VERSUS THEIR TROPHIC GRADIENT; III. CHEMISTRY OF THE WATER IN 41 LAKES,
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland). Zaklad Hydrobiologii.
B. Zdanowski.
Ekologia Polska, Vol. 31, No. 2, p 287-308, 1983. 3 Fig, 2 Tab, 21 Ref.

Descriptors: *Lakes, *Trophic level, *Poland, Eutrophication, Stratification, Phosphorus, Nitrogen, Nutrients, Seasonal variation, Ammonia, Magnesium, Dimictic lakes, Polymictic lakes.

Water chemistry was studied in 41 lakes in the north-eastern region of Poland. In each of the two types, dimictic and polymictic lakes, three lake groups were distinguished, differing in the content of phosphorous in the epilimnion. A comparison of variations in the content of chemical components in water during the growing season in the mictic type and their trophic groups indicates that an increase of trophic state of the lakes studied is characterized by: an increase in spring and summer concentration of phosphates, total organic and dissolved and particulate organic phosphorus; a growth of total organic, dissolved organic and particulate organic nitrogen; an increase in the content of ammonia in the surface and near-bottom water layers in both mictic types in spring, and an increase in the content of ammonia in the surface and near-bottom water layers in polymictic lakes in summer; a growth of the concentration of nitrates in both layers of dimictic lakes in spring; an increase in the content of calcium, potassium, bicarbonates, water oxidability and electrolytical conductivity in both layers and mictic types in spring and summer; and a growth of the content of magnesium in dimictic lakes. A high trophic state of lakes under the influence of pollution is indicated by high levels of total phosphorus and total nitrogen, summer concentration of ammonia and nitrites in the surface water layers of polymictic lakes; high summer content of ammonia at the bottom of dimictic lakes; high content of calcium, potassium, sodium, chlorides, sulfates, and carbonates; a high level of oxidability and electrolytic conductivity of water, but lower percentages of calcium and bicarbonates, at higher percentage of sodium, potassium and chlorides in the ion balance; high summer and spring concentration of phosphates, as well as their percentage in total phosphorus in the epilimnion. (Baker-IVI)
W84-03518

ECOLOGICAL AND CHARACTERISTICS OF LAKES IN NORTH-EASTERN POLAND VERSUS THEIR TROPHIC GRADIENT; IV. CHEMISTRY OF BOTTOM SEDIMENTS IN 37 LAKES,
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland). Zaklad Hydrobiologii.
B. Zdanowski.
Ekologia Polska, Vol. 31, No. 2, p 309-331, 1983. 4 Fig, 2 Tab, 9 Ref.

Descriptors: *Lake sediments, *Trophic levels, *Poland Nitrogen, Phosphorus, Bottom sediments, Organic matter, Seasonal variation, Chemical analysis, Dimictic lakes, Polymictic lakes.

Concentrations of organic matter, total, organic and mineral phosphorus, and of organic nitrogen were compared for bottom sediments in 37 lakes in north-eastern Poland. Studies were carried out during spring circulation and during summer stagnation. In dimictic lakes, the content of total phosphorus and total nitrogen in the near-bottom water layer increased in spring and summer together with the rising trophic state of the lakes. In bottom sediments the highest levels of total, organic and mineral phosphorus, of organic nitrogen and organic matter were found in lakes with the highest and those with the lowest trophic state. In dimictic lakes characterized by a high trophic state, the summer content of total phosphorus in the sediments was higher than the spring content. In other dimictic lakes the content of total phosphorus in sediments was lower in summer than in spring. Organic nitrogen in sediments increased in the summer in some dimictic lakes but decreased in others. In polymictic lakes, in spring and summer the content of total phosphorus in the near-bottom water layer increased. The content of total and organic phosphorus in the sediments of most polymictic lakes decreased in the summer, relative to the spring on an average of 23 and 26%. The bottom sediments of polymictic lakes did not differ much in respect to the content of organic nitrogen in spring. The content of organic nitrogen in the sediments of some lakes increased in summer on an average by 15%, relative to the spring level, whereas in the majority of lakes it decreased in the same period on an average by 15%, relative to the spring level. (Baker-IVI)
W84-03519

ECOLOGICAL CHARACTERISTICS OF LAKES IN NORTH-EASTERN POLAND VERSUS THEIR TROPHIC GRADIENT; V. CHLOROPHYLL CONTENT AND VISIBILITY OF SECCHI'S DISC IN 46 LAKES,
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland). Zaklad Hydrobiologii.
B. Zdanowski.
Ekologia Polska, Vol. 31, No. 2, p 333-351, 1983. 2 Fig, 2 Tab, 26 Ref.

Descriptors: *Lakes, *Trophic level, *Visibility, *Chlorophyll, *Poland, Seasonal variation, Dimictic lakes, Polymictic lakes, Phosphorus, Nitrogen, Silicates, Secchi disks, Bottom sediments.

The lakes under study varied in their morphology, trophic state and degree of anthropogenic impact. For spring, significant positive correlations were found between content of total phosphorus in the epilimnion and chlorophyll. No such correlation was noted with total nitrogen or silicates. In summer, highly significant positive correlations were noted between concentration of total phosphorus and content of chlorophyll and less significant positive correlation was noted between content of total nitrogen and chlorophyll. No correlation was found with silicates. For spring and summer, highly significant negative correlation

was found between concentrations of chlorophyll and the visibility of Secchi's disc. Changes in the average content of total phosphorus and total nitrogen in lakes of both mictic types and in both periods were accompanied by a decrease of the weight ratio of nitrogen to phosphorus. In spring and summer, visibility decreased as the trophic state increased mainly in the dimictic lakes, while in the polymictic lakes it was clearly higher in the group of lakes of the highest trophic state. These findings confirm the view that an increase in the content of total phosphorus in the epilimnion of polymictic lakes is the result of its inputs from bottom sediments, and to a lesser extent of higher summer concentration of chlorophyll and lower visibiliy in these lakes. (Baker-IVI)
W84-03520

ECOLOGICAL CHARACTERISTICS OF LAKES IN NORTH-EASTERN POLAND VERSUS THEIR TROPHIC GRADIENT; VI. THE PHYTOPLANKTON OF 43 LAKES,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
I. Spodniewska.
Ekologia Polska, Vol. 331, No. 2, p 353-381, 1983. 11 Tab, 13 Ref.

Descriptors: *Phytoplankton, *Lakes, *Trophic levels, *Poland, Biomass, Species diversity, Eutrophication, Dimictic lakes, Polymictic lakes.

The biomass and structure of spring and summer phytoplankton of 24 deep, dimictic lake and 19 shallow, polymictic lakes were analyzed. The differentiation of phytoplankton biomass in particular lakes was greater in summer than in spring, and greater in polymictic lakes than in dimictic ones. In spring, blooms were recorded in three dimictic lakes and in nine polymictic lakes. In summer, blooms were noted in 10 dimictic lakes and in 15 polymictic lakes. In spring the most intensive water blooms were noted in three polymictic lakes. All had total phosphorus concentrations above 100 micrograms/liter. Two were considerably polluted. In summer a phytoplankton biomass about 30 mg/liter was noted in 9 very fertile polymictic lakes. In spring the nanoplankton contributed considerably to the total biomass of algae, both in dimictic and polymictic lakes. In summer the contribution of nanoplankton to total phytoplankton biomass was smaller than in spring, especially low in the most fertile polymictic lakes. The blue-green algae dominated the plankton of more fertile lakes. Dinoflagellates dominated in less fertile dimictic lakes. (Baker-IVI)
W84-03521

ECOLOGICAL CHARACTERISTICS OF LAKES IN NORTH-EASTERN POLAND VERSUS THEIR TROPHIC GRADIENT; VII. VARIATIONS IN THE QUANTITATIVE AND QUALITATIVE STRUCTURE OF THE PELAGIC ZOOPLANKTON (ROTATORIA AND CRUSTACEA) IN 42 LAKES,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
A. Karabin.
Ekologia Polska, Vol. 31, No. 2, p 383-409, 1983. 6 Fig, 3 Tab, 32 Ref.

Descriptors: *Poland, *Trophic level, *Ecology, *Lakes, Eutrophication, Zooplankton, Rotatoria, Crustacea, Bioindicators, Water pollution effects.

First attempts to determine the relation between the trophic state of lakes and the zooplankton colonizing them have been based on a faunistic analysis, thus searching for a relation between the occurrence of a given species in the lake and the trophic state. The aim is to determine a comprehensive analysis of zooplankton structure (numbers, biomass, specific and group structure) and its changes together with increasing trophic state of lakes differing in morphometry and degree of pollution. Only changes in the numbers of Rotatoria are directly connected with the increasing trophic state in lakes. The biomass ratio of Cyclopoida and Cladocera increases at first with a trophic state increase, but tends to decrease again in extremely eutrophic lakes. Quantitative parameters of zooplankton structure undergo considerable fluctuations, independently of lake trophic state. (Murphy-IVI)
W84-03522

ECOLOGICAL CHARACTERISTICS OF LAKES IN NORTHERN-EASTERN POLAND VERSUS THEIR TROPHIC GRADIENT; VIII. ROLE OF NUTRIENT REGENERATION BY PLANKTONIC ROTIFERS AND CRUSTACEANS IN 42 LAKES,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
J. Ejsmont-Karabin.
Ekologia Polska, Vol. 31, No. 2, p 411-427, 1983. 4 Fig, 1 Tab, 24 Ref.

Descriptors: *Trophic levels, *Poland, *Lakes, *Ecology, Rotifers, Crustaceans, Nutrient removal, Cycling nutrients, Phosphorus, Phosphorus removal, Nitrogen, Nitrogen removal, Regeneration, Zooplankton, Eutrophication.

Lake eutrophication is a process leading to an increased pool of nutrients contained in a lake. If not expelled from an ecosystem permanently, these nutrients are recycled within it. The recycling consisting of rapid continual changes of their chemical forms. Analyses have been carried out of the rate of phosphorus and nitrogen regeneration by the zooplankton of 42 lakes representing a trophic and morphometric gradient. In unpolluted lakes, regardless of the type of mixis, an increase in total-P concentration was accompanied by a rise in the rate of P and N regeneration by the zooplankton, a reduction of the turnover time of P and a decrease in the value of the N:P ratio in excretion products. In polluted lakes no significant relationship has been found between the pool of P in the water and the rate of regeneration, but a considerable increase was found in the turnover time of P. Directional changes in the rate of P and N regeneration by the zooplankton, as well as a reduction of the N:P ratio, following an increase in the nutrient content of water bodies may play a significant role in changes in the value of primary production in the course of eutrophication. The cause of differences in the reaction of polluted water bodies to changes in the total-P concentration suggests that being limited by factors other than the trophic conditions, the zooplankton of such water bodies are unable to efficiently mineralize excess P input. (Murphy-IVI)
W84-03523

ECOLOGICAL CHARACTERISTICS OF LAKES IN NORTH-EASTERN POLAND VERSUS THEIR TROPHIC GRADIENT IX. THE MACROBENTHOS OF 44 LAKES,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
R. J. Wisniewski, and K. Dusoge.
Ekologia Polska, Vol. 31, No. 2, p 429-457, 1983. 3 Fig, 7 Tab, 25 Ref.

Descriptors: *Dimictic lakes, *Polymictic lakes, *Water circulation, *Stagnant water, *Macrobenthos, Trophic level, Phosphorus, Poland, Ecology, Taxonomy.

During the spring circulation and summer stagnation the macrobenthos of 24 dimictic and 20 polymictic lakes has been investigated in order to estimate their trophic state and purity, and to analyze the main ecosystem components with regard to their significance as indicators of the trophic state. In the profundal of dimictic lakes in the density and biomass of macrobenthos (especially the burrowing forms) show a tendency to decrease when the trophic state increases. With the advancing trophic state and the increase in depth the benthic fauna has became less varied. This was followed by a significant negative correlation of Shannon's index of species diversity with the trophic state of lakes determined on the basis of Ptot concentration in the water of epilimnion. (Murphy-IVI)
W84-03524

ECOLOGICAL CHARACTERISTICS OF LAKES IN NORTH-EASTERN POLAND VERSUS THEIR TROPHIC GRADIENT XI. MEIOBENTHOS AND NEAR-BOTTOM MEIOFAUNA IN 20 LAKES,
Warsaw Univ. (Poland). Dept. of Hydrobiology.
K. Prejs, and K. Papinska.
Ekologia Polska, Vol. 31, No. 2, p 477-493, 1983. 1 Fig, 8 Tab, 13 Ref.

Descriptors: *Dimictic lakes, *Trophic levels, *Meiobenthos, *Meiofauna, Lake eutrophication, Bottoms sedments, Crustaceans, Nematodes, Ecology, Poland.

The environmental changes occurring in the profundal are connected with eutrophication and result in the phenomenon of oxygen deficit in the hypolimnion maintained for gradually longer periods of time. This is reflective of the animals living there. Species that are sensitive to deteriorating oxygen conditions are replaced by more resistant forms. The objective is to determine the relationship between some regularities in the occurrence of meiofauna and the gradient of lake eutrophication. Composition, numbers, biomass and species differentiation of meiobenthos and meiofauna in near-bottom water were analyzed in 20 dimictic lakes of different gradient of eutrophication. The highest species diversity of near-bottom meiofauna, near-bottom Cyclopoida and Nematoda, was observed in lakes with the least advanced trophic state. The correlation between commonly used indices of the trophic state of lakes and the above mentioned meiofauna characteristics was significant. (Murphy-IVI)
W84-03525

ECOLOGICAL CHARACTERISTICS OF LAKES IN NORTH-EASTERN POLAND VERSUS THEIR TROPHIC GRADIENT XII. DEPENDENCE OF CHOSEN INDICES OF STRUCTURE AND FUNCTIONING OF ECOSYSTEMS ON TROPHIC STATUS AND MICTIC TYPE OF 42 LAKES,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
Z. Kajak.
Ekologia Polska, Vol. 31, No. 2, p 495-530, 1983. 4 Fig, 6 Tab, 22 Ref.

Descriptors: *Polymictic lakes, *Dimictic lakes, *Trophic level, Mixis, Ecosystems, Phosphorus, Phytoplankton, Biomass, Epilimnion, Zooplankton, Poland.

To compile the results of complex studies on 42 lakes representative for lakelands in north-eastern Poland it was necessary to include information on the characteristics of drainage basin, physical and chemical characteristics of lakes, phytoplankton, zooplankton and its role in phosphorus and nitrogen circulation, macrobenthos and meiobenthos. This allows a characterization of the structural and functional characters of their ecosystems according to their trophic status and mixis. Biomass of phytoplankton (mainly blue-green algae) and of rotifers increase to the highest phosphorus concentrations in polymictic lakes, and reach much higher values than in dimictic ones. As the trophic state (Measured by Ptot) increases the percentage of phosphate phosphorus in Ptot increases as well as total nitrogen concentration (while the N:P ratio decreases), chlorophyll concentration, biomass of phytoplankton and blue-green algae, the contribution of blue-green algae to phytoplankton biomass, efficiency of phosphorus utililzation by blue-green algae and of nitrogen phytoplankton, numbers and biomass of rotifers. But the number of crustaceans undergo very little changes. Polymictic lakes have a higher trophic state than dimictic ones, mainly because more nutrients are returned from the bottom sediments to the water. This increase is observed up to the highest phosphorus concentrations recorded, whereas in dimictic lakes the biomass becomes rather stable at mean concentrations. Thus the efficiency of phosphorus utilization by phytoplankton is better in polymictic lakes. Despite all the regularities connected with changes of total phosphorus concentration in epilimnion the scatter of values (around the mean) is very high for particular lakes. Not many species can be treated

as definite indicators of the trophic state. (Murphy-IVI)
W84-03526

HABITAT EXPLOITATION BY LARVAE OF AMPHIPSYCHE MERIDIANA (TRICHOPTERA: HYDROPSYCHIDAE) IN A JAVANESE LAKE OUTLET,
Newcastle upon Tyne Univ. (England). Dept. of Zoology.
P. J. Boon.
Freshwater Biology, Vol. 14, No. 1, p 1-12, February, 1984. 5 Fig, 2 Tab, 40 Ref.

Descriptors: *Dam screens, *Intake screens, *Trichopteran, *Population density, Population dynamics, Flow, Ecosystems, Insect behavior, Larvae, Tuntang River, Java.

Trichopteran populations below a dam on the River Tuntang (Central Java) and on intake screens above the dam consisted almost exclusively of Amphipsyche meridiana. Larvae on dam screens were in tightly packed aggregations, with greater densities in deeper water, and were predominantly fourth or fifth instars during the period of observation. Below the dam, 40% of larvae were in the first three instars. Larvae at the dam screens were heavier and yielded larger emerging adults which contained more eggs per female. Mean net mesh sizes of fifth instar larvae varied greatly from 34 X 26 micrometer to 125 X 106 micrometer with larger mesh size possibly being positively correlated with faster flow rates. The dinoflagellate Peridinium, commonly found in the guts of larvae below the dam, was virtually absent in dam screen larvae, possibly due to mesh size differences. The behavior of larvae in aggregations was observed in a laboratory flow channel. After experimental destruction of feeding nets, larvae immediately ingested silk prior to the construction of a new net. Nets were spun in a 'figure 8' fashion, and took between 11 and 30 min to complete. Stridulation between larvae occurred frequently and may be related to the defence of silk reserves within territories. (Murphy-IVI)
W84-03527

PRODUCTION OF A STREAM SHREDDER, PELTOPERLA MARIA (PLECOPTERA: PELTOPERLIDAE) IN DISTURBED AND UNDISTURBED HARDWOOD CATCHMENTS,
Georgia Univ., Athens. Dept. of Entomology.
For primary bibliographic entry see Field 5C.
W84-03528

MACROINVERTEBRATE-HABITAT RELATIONSHIPS IN THE RIVER TEIFI CATCHMENT AND THE SIGNIFICANCE TO CONSERVATION,
Welsh Water Authority, Powys (Wales).
R. A. Jenkins, K. R. Wade, and E. Pugh.
Freshwater Biology, Vol. 14, No. 1, p 23-42, February, 1984. 4 Fig, 7 Tab, 24 Ref.

Descriptors: *Macroinvertebrates, *Teifi River, *Catchment areas, *Conservation, Population density, Regression analysis, Habitats, Altitude, River width, Hydrogen ion concentration, Resource value.

A macroinvertebrate survey of various habitats (e.g. riffles, pools, tree roots) at sixteen sites in the Teifi catchment in September 1981 yielded 217 taxa excluding Hydracarina and Chironomidae. Sites with the greatest number of habitats were generally rich in taxa and supported the highest number of 'rare' species, the latter generally being associated with vegetation. However, species were not generally restricted to particular habitats although ecdyonurid mayflies predominated in riffles and one leptocerid caddisfly was principally collected from tree roots. Four groups of taxa which characterized three habitat groups were established using classification procedures and it was concluded that three habitat types (eroding, depositing and vegetation) should be sampled to describe adequately the macroinvertebrate fauna at each site. Three attributes (species richness, species rarity and site uniqueness) were used to establish the conservational value of each site; in general, the main river and one lowland tributary were of highest conservational signficance. Multiple regression analyses were used to establish significant relationships between the three attributes and environmental features such as number of habitats, altitude, river width, pH and total hardness. Such relationships may facilitate a rapid assessment of resources value without expensive biological survey. (Author's abstract)
W84-03529

BIOLOGY OF THE CATFISH CHRYSICHTHYS AURATUS (GEOFFORY) IN THE MAN-MADE TIGA LAKE IN NORTHERN NIGERIA,
Bayero Univ., Kano (Nigeria). Dept. of Biological Sciences.
M. G. De L. Sturm.
Freshwater Biology, Vol. 14, No. 1, p 43-51, February, 1984. 5 Fig, 4 Tab, 22 Ref.

Descriptors: *Catfish, *Tiga Lake, *Nigeria, Biological properties, Fish behavior, Artificial lakes, Population dynamics, Spawning.

A study was made of the biology of Chrysichthys auratus, a bottom-feeding omnivore, in Tiga Lake, a man-made lake in Northern Nigeria. Ripe females were present from April to September, coinciding with the hot season and rise in water level. First spawning took place at age II in females. No ripe males were found, and this was attributed to their spatial separation. Absolute fecundity was related to length and ranged from 327 to 1466 in forty-six females. Hyaline rings on the centra of lumbar vertebrae were counted to age 235 fish. The first ring is laid down at the end of the second year, after which the rings were formed annually, probably during the breeding season. The fish live for up to 6 years. There is a good fit of the growth curve to the von Bertalanffy equation. Growth is slow and a smaller maximum size is attained in the lake than in rivers. (Murphy-IVI)
W84-03530

ATP AS A BIOMASS INDICATOR IN EIGHT NORTH ISLAND LAKES, NEW ZEALAND,
Ministry of Works and Development, Hamilton (New Zealand). Water and Soil Science Centre.
R. D. Pridmore, A. B. Cooper, and J. E. Hewitt.
Freshwater Biology, Vol. 14, No. 1, p 73-78, February, 1984. 2 Fig, 2 Tab, 22 Ref.

Descriptors: *Adenosine triphosphate, *Biomass, *Lakes, *New Zealand, Carbon, Surface water, Biological properties, Mathematical equations, Bioindicators.

The determination of microbial biomass is often an essential step in the understanding and quantification of biological processes in aquatic ecosystems. The relationship between microbial ATP and biomass-carbon in the near surface waters (0.5-5 m) of eight New Zealand lakes was studied to determine the constancy of the carbon:ATP ratio under natural growth conditions. Concentrations of microbial carbon were estimated indirectly from cell volume determinations. The carbon:ATP ratio remained reasonably constant (interquartile range 248-291, n = 50), except during periods of nitrogen/phosphorus deficiency when carbon:ATP ratios increased to values greater than 400. During periods of nitrogen/phosphorus sufficiency, corresponding estimates of microbial ATP and biomass-carbon were strongly correlated (r = 0.97, n = 47) and related by the equation carbon = (287 + or - 20) ATP-(22 + or - 41) where carbon and ATP are expressed in mg/cu m. From this relationship an average carbon:ATP ratio of 267 (SE = 5) was calculated. This ratio was not significantly affected by the relative proportions of bacterial and algal biomass in the surface water samples. However, because of the marked deviation of the carbon:ATP ratio during periods of nitrogen/phosphorus deficiency, the routine use of ATP as a biomass indicator is discouraged. (Murphy-IVI)
W84-03531

SEASONAL CHANGES IN THE CONCENTRATION AND COLOUR OF HUMIC SUBSTANCES IN SOME AQUATIC ENVIRONMENTS,
Laval Univ., Quebec. Dept. of Soil Science.
For primary bibliographic entry see Field 5B.
W84-03532

FRESH WATERS OF SHETLAND: PHYSICAL AND MORPHOMETRIC CHARACTERISTICS OF LOCHS,
Institute of Terrestrial Ecology, Edinburgh (Scotland).
D. G. George, and P. S. Maitland.
Freshwater Biology, Vol. 14, No. 1, p 95-107, February, 1984. 7 Fig, 5 Tab, 21 Ref.

Descriptors: *Fresh waters, *Shetland, *Physical properties, *Morphology, Lochs, Ecology, Climate, Geology, Retention time, Sedimentation, Scotland.

The Shetland Island group lies 150 km to the north of mainland Britain, and has recently been developed as a center for oil exploration and production activities in the northern North Sea. Surveys were intended to provide an information base for planning decisions related to industrial developments on the islands. Basic physical and morphometric data were taken for sixty-five lochs on the islands. The interrelations between loch dimensions are comparable to those recorded elsewhere in Scotland, but the smaller lochs on Shetland tend to be somewhat shallower, and the large lochs somewhat deeper than usual. The flat bottomed nature of the small peaty pools presumably reflects the topographical processes involved in the formation and erosion of blanket peat. The greater depth of the larger stony basins, however, implies that the rate of sediment accumulation is fairly low. The streams draining into the lochs are often rich in allochthonous material since strong winds and driving rain cause rapid soil erosion on exposed slopes when vegetation is sparse. The results of a multivariate analysis show that most of the physical variables measured in the field are closely correlated with easily measured map attributes. (Murphy-IVI)
W84-03533

DIGEST OF WATER QUALITY OF THREE CENTRAL ILLINOIS IMPOUNDMENTS,
Illinois State Water Survey, Peoria. Water Quality Section.
S. D. Lin, and R. L. Evans.
Transactions of the Illinois State Academy of Science, Vol. 76, No. 1 and 2, p 277-280, 1983. 1 Tab, 2 Ref.

Descriptors: *Water quality, *Illinois, *Impoundments, Canton Lake, Decatur Lake, Eureka Lake, Transparency, Water temperature, Dissolved oxygen, Turbidty, Hydrogen ion concentration, Alkalinity, Ammonia, Nitrogen compounds, Phosphorus compounds, Iron, Manganese, Sulfate, Chlorine demand, Chemical oxygen demand, Total organic carbon, Silica, Threshold odor number, Algae, Actinomycetes, Standard plate count.

Samples from Lakes Canton, Decatur, and Eureka were collected weekly for over 2 years and were analyzed for 22 parameters. These parameters are transparency, water temperature, dissolved oxygen (DO), turbidity, pH, alkalinity, hardness, ammonia and nitrate nitrogen, dissolved and total phosphorus, iron, manganese, sulfate, chlorine demand, chemical oxygen demand (COD), total organic carbon (TOC), silica, threshold odor number (TON), algae, standard plate count (SPC), and actinomycetes. The transparency in Lake Canton was generally greater than that in Lakes Eureka and Decatur. The temperature stratification barrier for L. Canton and L. Eureka occurred at 12 to 14 feet and 4 to 10 feet, respectively, for about six months every year from mid-April to mid-October. The thermal stratification of the lakes was not a barrier to the anaerobic zone penetrating the overlying waters. In general, except during the summer stagnation periods, hardness, COD, and TOC in all lakes did not change in water column. In L. Decatur concentrations of pH, alkalinity, nitrate, sulfate, chlorine demand, and silica did not change on the

vertical. At the surface and mid-depth of L. Canton and L. Eureka, the turbidity, alkalinity, nitrate nitrogen, and sulfate concentrations were not significantly different. The magnitude of taste and odor in the three lakes was found to be a seasonal function. Water temperature and sulfate concentrations in the three lakes were well within the IPCB limits. Most of the water quality parameters exhibited no seasonal or yearly variation. There was no correlation between parameters except for TON vs. nitrate, sulfate, manganese, and chlorine demand. Much of these inter-reactions are still unknown. Thus, modeling a complicated natural system should be discouraged until the nature and rates of interactions are better defined. (Murphy-IVI)
W84-03547

OCCURRENCE OF OECETIS INCONSPICUA (WALKER) IN AN ACID STRIP-MINE LAKE OF SOUTHERN ILLINOIS,
Southern Illinois Univ. at Carbondale. Dept. of Zoology.
S. Zullo, and N. Bates.
Transactions of the Illinois State Academy of Science, Vol. 76, No. 3 and 4, p 293-296, 1983. 2 Tab, 21 Ref.

Descriptors: *Trichoptera, *Strip mine lakes, *Acidic water, *Illinois, Hydrogen ion concentration, Species composition, Aquatic habitats.

This study reports for the first time the finding of Oecetis inconspicua (Walker) in an acid-strip mine lake of southern Illinois. The caddisfly larvae and pupae were found among Typha latfolia detritus in less than one meter of water. Chemical composition of the surrounding water is typically rich in dissolved ions. The pH is around 3.2. Total dissolved solids concentration approaches 2450 mg/l. Species identification is important in all studies, but perhaps it is even more important in studies in acid strip-mine lakes because habitat conditions are vital to the species able to survive there. (Murphy-IVI)
W84-03548

WORK ENERGY IN A FINAL-CUT STRIP MINE LAKE IN SOUTHERN ILLINOIS,
Southern Illinois Univ. at Carbondale. Dept. of Zoology.
M. J. Chimney.
Transactions of the Illinois State Academy of Science, Vol. 76, No. 1 and 2, p 297-303, 1983. 4 Tab, 20 Ref.

Descriptors: *Work energy, *Strip mine lake, *Illinois, Birgean Work, Schmidt Stability, Total Direct Work, Moroni's Big Lake, Mathematical studies.

Calculation of the work parameters provides useful comparative data on the lacustrine energy dynamics within a lake. The work parameters: Birgean Work (B), Schmidt Stability (S), and Total Direct Work (G), were calculated for a final-cut strip mine impoundment located in southern Illinois using density data compensated for 1) temperature (= uncorrected work parameters: B, S, G) and 2) temperature, pressure, and salinity (= corrected work parameters: B', S', G'). Maximum work energies ocurred after the summer solstice and were comparable to levels observed in similar holomictic lakes. In general, $B' < B$, $S' > S$, and $G' < G$; These differences were attributed mainly to salinity; pressure was less important. Corresponding corrected and uncorrected work parameters were highly correlated with, and at the same time statistically different from, each other. Only differences between B' and B were regarded as limnologically significant however. (Murphy-IVI)
W84-03549

INITIAL ASSESSMENT OF TIME OF TRAVEL AND MIXING THROUGH GULF ISLAND POND AND THE LOWER ANDROSCOGGIN RIVER, MAINE,
Geological Survey, Augusta, ME. Water Resources Div.
For primary bibliographic entry see Field 2E.
W84-03552

WATER QUALITY OF SOMERVILLE LAKE, SOUTH-CENTRAL TEXAS,
Geological Survey, Austin, TX. Water Resources Div.
E. McPherson, and H. B. Mendieta.
USGS Water-Resources Investigations Report 82-4124, 1983. 88 p, 20 Fig, 17 Tab, 25 Ref.

Descriptors: *Water quality, Surface water, Dissolved oxygen, Iron, Manganese, Nitrogen, Phosphorus, Dissolved solids, Chloride, Sulfate, Hardness, *Texas, Somerville Lake.

Lake Somerville in south-central Texas has excellent water for municipal, industrial, and agricultural use. The total dissolved solids of the water averaged 220 milligrams per liter during a study from 1975-80. This shallow lake has a mean depth of 14 feet. The average annual inflow and discharge is greater than the volume of the lake. These two factors, along with wind action and the cooling of surface water during both summer and winter keep the lake well mixed and aerated. Even in summer the dissolved oxygen concentrations at the bottom of the lake usually were in excess of 50 percent of saturation. Dissolved iron concentrations are less than 50 micrograms per liter and dissolved manganese concentrations are under 40 micrograms per liter. These small concentrations are largely attributable to year-round oxygenated water. Homogeneous or near homogeneous concentrations of total phosphorus and inorganic nitrogen can occur at any time of the year throughout the lake. Dissolved chloride concentrations averaged 43 milligrams per liter and dissolved sulfate concentrations averaged 63 milligrams per liter. The total hardness of the water averaged about 110 milligrams per liter, placing it in the moderately hard classfication. (USGS)
W84-03583

WATER QUALITY OF LAKES FAITH, HOPE, CHARITY, AND LUCIEN, 1971-79, IN AN AREA OF RESIDENTIAL DEVELOPMENT AND HIGHWAY CONSTRUCTION AT MAITLAND, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
E. R. German.
USGS Water-Resources Investigations Report 82-51, 1983. 71 p, 18 Fig, 18 Tab, 14 Ref.

Descriptors: *Water quality, *Lakes, Runoff, Precipitation, *Florida, Orange County, Seminole County, Maitland.

Lakes Faith, Hope, and Charity were sampled from April 1971 to June 1979 to monitor water quality before, during, and after construction of Maitland Boulevard and the Interstate Highway 4 interchange. Lake Lucien was added to the study in April 1975. Chemical quality of the lakes varies little in comparison with surface runoff, bulk precipitation, and the water in the surficial aquifer. Surface runoff supplied about 19 percent of the direct inflow to the lakes and contributed a total of about 2,000 pounds, per acre of lake surface, of dissolved solids from April 1971 to June 1979, while bulk precipitation contributed about 1,170 pounds per acre. Water quality in the lakes changed during the study, generally for the better. However, an infestation of elodea (Hydrilla verticillata), whose growth is not associated with water quality, developed in Lake Hope near the end of the study and has interfered with recreational use of the lake. (USGS)
W84-03596

RELATIONSHIP BETWEEN LAKE TROPHIC LEVEL AND LAKE SEDIMENTS,
National Swedish Environment Protection Board, Uppsala (Sweden). Water Quality Lab.
L. Hakanson.
Water Research, Vol. 18, No. 3, p 303-314, 1984. 4 Fig, 8 Tab, 64 Ref.

Descriptors: *Lake sediments, *Trophic level, Nutrients, Phosphorus, Carbon, Nitrogen, Chlorophyll, Transparency, Sedimentation, Lakes.

The relationship between lake type, as expressed by various trophic characteristics, and sediment type, as expressed by determinations of simple chemical data on nitrogen, phosphorus, carbon and loss on ignition was studied. A BPN-value (bioproduction number), defined by the slope coefficient of the regression line between N-content and IG-content of surficial sediments provides most accurate information about lake trophic level on the scale from oligotrophy to eutrophy, provided that more than 50% of the lake area has lower loss on ignition than 20%. The BPN-value cannot be used as an indicator of trophic level if the IG-content is predominantly higher than 30% in a lake. In the latter case the ratio IG/N can be used as a means to differentiate lake humic level. The BPN-value, which is determined from sediment samples providing an even spread throughout the lake surface, yields lake typical information, whereas C/N rations yield site specific information. A diagrammatic interpretation between lake trophic type and lake sediments was developed. (Baker-IVI)
W84-03732

EFFECT OF OXYGEN CONCENTRATION ON THE RATES OF DENITRATIFICATION AND DENITRITIFICATION IN THE SEDIMENTS OF AN EUTROPHIC LAKE,
Kyushu Univ., Fukuoka (Japan). Dept. of Chemical Engineering.
M. Nakajima, T. Hayamizu, and H. Nishimura.
Water Research, Vol. 18, No. 3, p 335-338, 1984. 5 Fig, 16 Ref.

Descriptors: *Denitritification, *Denitratification, *Lake sediments, *Eutrophic lakes, Oxygen demand, Sediments, Nitrates, Nitrites, Acetylene inhibition method.

The acetylene inhibition method was used during initial 1 hr incubation periods after preculture under complete anaerobic conditions to determine the effect of oxygen concentration on the rates of denitratification and denitritification for wide ranges of nitrate and nitrite concentrations. Sediment samples were collected for use from a highly eutrophic lake. A maximum denitratification rate of 4 micromol/hr was obtained under anaerobic conditions. The denitratification rate was a decreasing function of the oxygen concentration below 60 microM. About the same rate was noted for denitritification in the range below 30 microM oxygen. Beyond 30 microM oxygen, this rate dropped to half of the maximum, and remained almost constant until a critical oxygen concentration was obtained. The critical concentration, above which denitritification was suppressed thoroughly, depended on nitrite concentration. The rates of denitritification and denitratification under anaerobic conditions increased approximately proportionally to the temperature between 5-30 C. The rate of denitritification was always higher than that of denitratification at each temperature under 160 microM nitrate or nitrite concentration. (Baker-IVI)
W84-03735

CONTRIBUTION TO THE PHYSICO-CHEMICAL LIMNOLOGY OF SWARTVLEI,
Rhodes Univ., Grahamstown (South Africa). Inst. of Freshwater Studies.
For primary bibliographic entry see Field 2L.
W84-03744

EXTERNAL BUDGETS FOR PHOSPHORUS, NITROGEN AND DISSOLVED ORGANIC CARBON FOR THE ACIDIFIED LAKE GARDSJON,
Uppsala Univ. (Sweden). Limnologiska Institutionen.
O. Broberg, and G. Persson.
Archiv fur Hydrobiologie, Vol. 99, No 2, p 160-175, January, 1984. 2 Fig, 5 Tab, 40 Ref.

Descriptors: *Limnology, *Oligotrophic lakes, *Nutrients, *Lake Gardsjon, Sweden, Phosphorus, Nitrogen, Dissolved solids, Acidification, Acid rain.

Lake Gardsjon is situated in an area with thin moraines and difficultly weathered rocks where

lakes have been acidified during recent decades due to acid rain. A residence time of water in the lake is 1.0 yr. Deposition on the lake surface is the largest source of phosphorus and nitrogen, but the surrounding land contributes most of the dissolved organic carbon (DOC) entering the lake. Precipitation in forested areas is further enriched in phosphorus and DOC during the passage through the canopy. Phosphorus is effectively trapped within the soil profile, probably through adsorbtion to aluminum and possibly to iron. Retention in Lake Gardsjon is low for phosphorus compared to mesotrophic and eutrophic lakes but may not largely differ from other oligotrophic lakes. DOC is effectively broken down or precipitated within the lake, causing a high transparency. The possible carrier function of humic substances for nitrogen and phosphorus is of less importance in this lake than in brownwater lakes. (Baker-IVI)
W84-03745

INVERTEBRATE FAUNA OF A SMALL CHALK STREAM IN BERKSHIRE, ENGLAND, AND THE EFFECT OF INTERMITTENT FLOW,

Freshwater Biological Association, Wareham (England). River Lab.
J. F. Wright, P. D. Hiley, D. A. Cooling, A. C. Cameron, and M. E. Wigham.
Archiv fur Hydrobiologie, Vol. 99, No. 2, p 176-199, January, 1984. 4 Fig, 3 Tab, 29 Ref.

Descriptors: *Intermittent streams, *Invertebrates, *England, *Winterbourne, Streams, Aquatic fauna, Stream flow, Species composition, Seasonal variation.

The invertebrate fauna of the Winterbourne, which has intermittent flow in its upper section, was examined for one year. An initial survey at 17 sites along the entire 8 km long stream in February was followed by a bimonthly survey at 10 downstream sites until December. The distribution of species was analyzed and related to the flow regime. A total of 233 taxa were recorded. Examination of the species lists for each site demonstrated a marked discontinuity in the distribution of many species around the perennial head. This feature was also highlighted using cluster analysis. Species which were restricted to either intermittent or perennial sites and which showed a high frequency of occurrence in the samples could therefore be of help in determining the location of the perennial head. A proposal that the fauna of temporary streams consists of three components (permanent stream species, facultative species and specialized species) was examined in light of the species reported for the intermittent sites in the Winterbourne. (Baker-IVI)
W84-03746

TRIBUTARIES AS MODIFIERS OF THE RIVER CONTINUUM CONCEPT: ANALYSIS BY POLAR ORDINATION AND REGRESSION MODELS,

Sam Houston State Univ., Huntsville, TX. Div. of Life Sciences.
D. A. Bruns, G.W. Minshall, C. E. Cushing, K. W. Cummins, and J. T. Brock.
Archiv fur Hydrobiologie, Vol. 99, No. 2, p 208-220, January, 1984. 3 Fig, 3 Tab, 11 Ref.

Descriptors: *Benthic environment, *Rivers, *Tributaries, River Continuum Concept, Particulate matter, Salmon River, Idaho.

Data was collected on functional groups and organic matter parameters at sampling sites of differing stream size above, within, and below tributaries of the Middle Fork of the Salmon River, Idaho to discern tributary effects upon river continuum relationships. The composition of functional groups and benthic and combined organic matter parameters varied as significant functions of link magnitude in regression analyses both with and without data from tributary-affected sampling sites. The composition of transport based on data without tributary effects also varied as a function of stream size, but with tributary-affected sites included in the analysis, a statistically significant pattern was not evident. Transport seems to be more susceptible to tributary alteration. Tributaries most strongly modified river continuum patterns in regard to gathering collectors, predators, periphyton, and transported ultra-fine particulate organic matter ranging in size from 0.45 to 52 micrometers. Small tributaries seemed to set community development forward along the river gradient and large tributaries tended to set it back. (Baker-IVI)
W84-03748

MIGRATION PATTERNS OF FIVE FISH SPECIES IN THE MURRAY-DARLING RIVER SYSTEM,

South Australia Dept. of Agriculture, Adelaide.
L. F. Reynolds.
Australian Journal of Marine and Freshwater Research, Vol. 34, No. 6, p 857-871, 1984. 3 Fig, 6 Tab, 21 Ref.

Descriptors: *Fish migration, *Rivers, *Murray River, *Darling River, Australia, South Australia, Migration, Population dynamics, Fish behavior, Carp, Catfish, Perch.

Of 14,333 fish tagged in a study carried out in the Murray River, South Australia from 1974 to 1978, 1276 were recaptured. Some golden perch moved extensively upstream, many moving more than 1000 km. The migration followed, and appeared to be triggered by, a rise in water level at the onset of major flooding. The upstream migrations, made only by mature fish, appear to be a reproduction strategy to ensure that the eggs are distributed downstream. Common carp, which lay adhesive, demersal eggs, did not migrate but made only random, short distance movements. While data on other species were fewer it appears that Murray cod and catfish, both of which have demersal eggs, show similar movement patterns to carp whereas silver perch, which lays buoyant eggs, is similar to golden perch. Since catfish and Murray cod maintain popultions without undergoing major upstream spawning migrations, it can be supposed that purely local events such as overfishing, pollution, destruction of spawning areas by river channelization and desnagging could seriously depress or even destroy local populations. (Baker-IVI)
W84-03749

ABUNDANCE, BIOMASS AND DIVERSITY OF BENTHIC MACRO-INVERTEBRATES IN A WESTERN CAPE RIVER, SOUTH AFRICA,

Cape Town Univ. (South Africa). Percy Fitzpatrick Inst. of African Ornithology.
J. M. King.
Transactions of the Royal Society of South Africa, Vol. 45, Part 1, p 11-34, August, 1983. 3 Fig, 7 Tab, 32 Ref.

Descriptors: *Rivers, *Biomass, *Environmental effects, *Water resources development, South Africa, Invertebrates, Macroinvertebrates, Benthic environment, Streams, Wastewater disposal, Stellenbosch, Eerste River.

The Eerste River, situated in southwestern Cape Province, South Africa, has its upper reaches in a stony substratum and can be divided into three physical/biotic zones: the Mountain Stream, Upper River, and Lower River zones. Faunal samples were collected at monthly intervals between March 1975 and April 1976, from eight stations along the river. Abundance and biomass generally increased downstream, but were low below a dam construction site due to blanketing effects of silt on the substratum. Seasonal changes in abundance and biomass of macro-invertebrates differed along the length of the river, because of the presence of dissimilar animal communities. Levels were always low in winter, and peaked in spring. Highest values in both were in the Lower River in summer, reflecting a build-up of organic pollutants there during times of low flow. Species diversity of the Ephemeroptera, which was felt to be representative of the diversity of the total macro-invertebrate fauna, decreased downstream. Major decreases in diversity could be correlated with major changes in the quality of the water: at a town and at a sewage-farm outfall. In the silt-laden waters below a dam construction site, the fleeting occurrence of individuals of several different ephemeropteran species resulted in a high diversity index. Composition of the fauna was typical of local rivers with mountain sources. (Baker-IVI)
W84-03751

MULTIPURPOSE RESERVOIR OPERATION; 1. MONTHLY MODEL FOR A SINGLE RESERVOIR,

California Univ., Davis. Dept. of Land, Air and Water Resources.
M. A. Marino, and B. Mohammadi.
Journal of Hydrology, Vol. 69, No. 1-4, p 1-14, February, 1984. 4 Fig, 3 Tab, 10 Ref. CSRS project CA-D-LAW-411H, OWRT project A-0880CAL, and WRC project UCAL-WRC-W-617.

Descriptors: *Multipurpose reservoirs, *Model studies, *Reservoir operation, Computers, Linear programming, Systems analysis, Reservoirs.

The monthly operational model of Becker and Yeh (Water Resour. Res., 10:1107-1112, 1974) which maximized energy output of a reservoir system has been extended to allow for maximization of both water and energy from the system. The model is a combination of LP (used for period-by-period) and DP (used for optimization over the entire operation period). At every stage of the DP, a series of LP's are solved. Since the contract levels of water and energy are usually based on conservative estimates of natural inflows, the system is likely to be capable of providing more than these contract levels. The efficiency of the algorithm is improved through the use of parametric LP (reduces computation time) and an iterative solution procedure (which reduces computation time and core-storage requirements). These efficiency measures allow the use of minicomputers, which are more suitable for frequent updating purposes because of their lower cost. The reservoir operation model can easily be adapted for use in multireservoir systems. The iterative solution procedure allows for consideration of more than two primary purposes with relatively low computation time. (Baker-IVI)
W84-03773

MULTIPURPOSE RESERVOIR OPERATION; 2. DAILY OPERATION OF A MULTIPLE RESERVOIR SYSTEM,

California Univ., Davis. Dept. of Land, Air and Water Resources.
B. Mohammadi, and M. A. Marino.
Journal of Hydrology, Vol. 69, No. 1-4, p 15-28, February, 1984. 2 Fig, 4 Tab, 16 Ref. CSRS project CA-D-LAW-4116-H, OWRT project A-088-CAL, WRC project UCAL-WRC-W-617.

Descriptors: *Multipurpose reservoirs, *Reservoir operation, Planning, Management, Computers, Systems analysis, Model studies, Energy, Shasta Reservoir, Folsom Reservoir, California.

Daily operation models often do not consider the multiobjective nature of a reservoir system. The majority of the available models require an initial guess of the operation policy. Although optimality can be reached, the execution time (and therefore the cost of running the model) depends on the initial solution. A daily operation model for maximization of monthly water and energy output from a system of two parallel reservoirs is presented. The model uses optimum monthly water and energy contract levels obtained from the monthly release policy. These contract levels are adjusted to allow for differences between the daily and monthly forecast of inflow. The model is developed using a minicomputer to provide an inexpensive tool for updating the system. The model is applied to the Shasta and Folsom reservoirs of the California Central Valley Project with computation time requirements of less than 2 min. (Baker-IVI)
W84-03774

SUSPENDED MATTER, MAJOR CATIONS AND DISSOLVED SILICON IN THE ESTUARINE WATERS ON THE MAHANADI RIVER, INDIA,

Utkal Univ., Bhubaneswar (India). Dept. of Geology.
For primary bibliographic entry see Field 2J.
W84-03783

RESIDENCE TIME: APPLICATION TO SMALL BOAT BASINS,
Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
For primary bibliographic entry see Field 5B.
W84-03798

ORGANIC AND INORGANIC SULFUR CONSTITUENTS OF THE SEDIMENTS IN THREE NEW YORK LAKES: EFFECT OF SITE, SEDIMENT DEPTH AND SEASON,
State Univ. of New York Coll. of Environmental Science and Forestry. Dept. of Environmental and Forest Biology.
M. J. Mitchell, D. H. Landers, D. F. Brodowski, G. B. Lawrence, and M. B. David.
Water, Air and Soil Pollution, Vol. 21, No. 1-4, p 231-245, January, 1984. 9 Fig, 2 Tab, 45 Ref.

Descriptors: *Organic sulfur, *Inorganic sulfur, *Sediments, *Lakes, Sediment distribution, Sulfur, Oligotrophic lakes, Mesotrophic lakes, Eutrophic lakes, Chemical properties, Deposition, Oneida Lake, South Lake, Deer Lake, New York.

Sulfur, an essential nutrient, is found in both organic and inorganic forms. In oxygenated water, sulfate is the most common form of inorganic S, while anoxic conditions permit formation of reduced inorganic spedies such as sulfides. Water and sediment parameters, with emphasis on S constituents, were compared among lakes (Oneida, South, Deer), seasons, sites and sediment depths. The three lakes differed in size, morphometry, productivity and acid neutralizing capacity and none of the lakes had anoxia in the water column. Redox potentials (Eh) were higher for oligotrophic south and mesotrophic Deer than eutrophic Oneida within the sediment. In the water column, the only S constituent measured was sulfate which was higher in nutrient rich Oneida (110 to 490 micromol/l) than South (30 to 70 micromol/l) or Deer (10 to 60 micromol/l). Total S in sediment was higher from South than for either Deer or Oneida. For Deer and South sediment, total S was greatest in the 5 to 15 cm layer, and this was likely due to historical changes in anthropogenic inputs through atmospheric deposition. The high S concentration in South sediment can be accounted for by particulate deposition of S through the water column. Organic S constituents constituted major forms of S in the sediments of the three lakes. Non-HI reducible S, of which carbon-bonded S was a dominant constituent, comprised a major portion of total S in Oneida, South and Deer. Ester sulfate was higher in Oneida than South or Deer. There was an inverse relationship between sediment Eh and sulfide. Pyritic S was measured on bulk samples and constituted 37, 12, and 6% of total S in Oneida, South and Deer. Both inorganic and organic S forms showed season variation and the transformation and translocation of these forms play an important role in the S dynamics of lakes. (Murphy-IVI)
W84-03834

DISTRIBUTION, ABUNDANCE AND CARBON ISOTOPIC COMPOSITION OF GASEOUS HYDROCARBONS IN BIG SODA LAKE, NEVADA: AN ALKALINE, MEROMICTIC LAKE,
Geological Survey, Menlo Park, CA.
R. S. Oremland, and D. J. Des Marais.
Geochimica et Cosmochimica Acta, Vol. 47, No. 12, p 2107-2114, December, 1983. 3 Fig, 3 Tab, 61 Ref.

Descriptors: *Big Soda Lake, *Nevada, *Alkaline water, Carbon, Meromictic lakes, *Hydrocarbons, Anoxic water, Bottom sediments, Gases, Ethylene, Propylene, Ethane, Propane, Isobutane, n-Butane, Methane, Water column, Sedimentology, Carbon radioisotopes, Mixolimnion.

Habitats favorable for the early, depositional stages of oil and gas formation probably include aquatic environments with permanently anoxic bottom waters whose sediments receive large inputs of organic matter from their productive surface waters. Only a few studies have characterized the low molecular weight gaseous hydrocarbons found within possible present-day analogues of such ancient anoxic, hypersaline environments. Distribution and isotopic composition (sigma C-13) of low molecular weight hydrocarbon gases were studied in Big Soda Lake (depth = 64 m), an alkaline, meromictic lake with permanently anoxic bottom waters. Methane increased with depth in the anoxic mixolimnion (depth = 20-35 m), reached uniform concentrations (55 microM/l) in the monimolimnion (35-64 m) and again increased with depth in monimolimnion bottom sediments (> 400 microM/kg below 1 m sub-bottom depth). The sigma C-13(CH4) values in bottom sediment below 1 m sub-bottom depth (< -70 per mil) increased with vertical distance up the core (sigma C-13(CH4) = -55 per mil at sediment surface). Monimolimnion C-13(CH4) values (-55 to -61 per mil) were greater than most sigma C-13(CH4) values found in the anoxic mixolimnion (92% of samples had sigma C-13(CH4) values between -20 and -48 per mil). No significant concentrations of ethylene or propylene were found in the lake. However ethane, propane, isobutane and n-butane concentrations all increased with water column depth, with respective maximum concentrations of 260, 80, 23 and 22 nM/l encountered between 50-60 m depth. Concentrations of ethane, propane and butanes decreased with depth in the bottom sediments. Ratios of CH4/(C2H6 + C3H8) were high (250-620) in the anoxic mixolimnion, decrease to approximately 161 in the monimolimnion and increased with depth in the sediment to values as high as 1736. We concluded that methane has a biogenic origin in both the sediments and the anoxic water column and that C2-C4 alkanes have biogenic origins in the monimolimnion water and shallow sediments. The changes observed in sigma C-13(CH4) and CH4/(C2H6 + C3H8) with depth in the water column and sediments are probably caused by bacterial processes. These might include anaerobic methane oxidation and different rates of methanogenesis and C2 to C4 alkane production by microorganisms. (Murphy-IVI)
W84-03862

NITROGEN BUDGET FOR A SMALL CONIFEROUS FOREST STREAM,
Geological Survey, Menlo Park, CA. Water Resources Div.
F. J. Triska, J. R. Sedell, K. Cromack, Jr., S. V. Gregory, and F. M. McCorison.
Ecological Monographs, Vol 54, No. 1, p 119-140, March, 1984. 3 Fig, 9 Tab, 106 Ref. NSF grants DEB 74-20744A02 and DEB 767-21402.

Descriptors: *Nitrogen budget, *Streams, Nitrogen cycle, Nitrogen, Nitrogen fixation, Allochthonous, Cycling nutrients, Oregon.

Small streams draining heavily forested watersheds depend on organic inputs from the adjacent terrestrial environment (Allochthonous) as a source of fixed carbon and nutrients for in situ biological processes. An annual nitrogen budget is presented for a small stream draining Watershed, 10, H. J. Andrews Experimental Forest, Oregon. The role of allochthonous debris in the input, flux, and export of nitrogen is emphasized in the material balance budget. All material entering the stream channel was presumed to enter the water sometime during the year. Material estimates are based on total channel area. The major annual nitrogen input (1974-1975) was subsurface flow (11.06 g/sq m) as dissolved organic nitrogen (10.56 g/sq m) and nitrate (0.05 g/sq m). Biological inputs of nitrogen amounted to 4.19 g/sq m as direct terrestrial inputs of: litterfall (1.35 g/sq m), lateral movement (1.78 g/sq m), and throughfall (0.30 g/sq m). Nitrogen fixation on fine wood debris contributed an additional 0.76 g/sq m based on rates from a nearby watershed. Total nitrogen input was 15.25 g/sq m. The nitrogen pool was dominated by large amounts of particulate organic matter. Coarse wood constituted 32% of the nitrogen pool (3.80 g/sq m) and fine wood fractions 18% (2.18 g/sq m). The coarse wood fraction greatly influenced stream morphology. Fine organic particulates constituted an additional 40% of the nitrogen pool (4.77 g/sq m). DON (dissolved organic nitrogen) export (8.38 g/sq m) was less than input, presumably due to biological uptake associated with litter mineralization, sorption, and chemical flocculation. Due to effective retention of particulate inputs by debris dams, biological processing in the particulate nitrogen pool, and uptake and sorption of DON, most particulate organic inputs increased in nitrogen concentration prior to export. Particulate organic nitrogen input (3.13 g/sq m) was greater than export (2.53 g/sq m). Total annual nitrogen output was 11.36 g/sq m, resulting in a gain of 3.89 g/sq m/yr to the stream. Thus, the stream was not operating on an annual steady state, but on an input-output regime related to the processing of refractory wood debris and resetting by major storms. Although particulate and dissolved nitrogen loss per hectare was small for the 10-ha watershed, these losses passed through or were accumulated in a pool encompassing < 1% of the watershed area. This concentration of N in the stream allowed establishment of a separate ecosystem whose processing efficiency and capabilities for nutrient cycling were related to the retention capacity of the channel and nutrient quality of inputs within the reach. (Murphy-IVI)
W84-03880

FISH ASSEMBLAGES IN A RIVER WITH UNUSUAL GRADIENT (LUONGO, AFRICA - ZAIRE SYSTEM), REFLECTIONS ON RIVER ZONATION, AND DESCRIPTION OF ANOTHER NEW SPECIES,
Guelph Univ. (Ontario). Dept. of Zoology.
E. K. Balon, and D. J. Stewart.
Environmental Biology of Fishes, Vol. 9, No. 3/4, p 225-252, 1983. 14 Fig, 5 Tab, 92 Ref.

Descriptors: *Rivers, *Fish, *Luongo River, Africa, Zaire System, Zones, Species diversity, Topography, Drainage basins, Spatial distribution.

Fish distribution was studied in a river with an unusual gradient within the drainage system of Zaire headwaters. The Luongo River has high gradient upper and lower sections, separated by a long middle section of no gradients, and bordered by rapids and waterfalls. On the basis of Luongo's hydrographic history, topography and fish taxocenes, the river is divided into saltatory zones, each one inhabited by separate homeostatic fish communities. The problem of river natural zonation is argued. Luongo River is also unique for its high richness containing 49 species, its biogeographical correlations, and the number of undescribed species found (14%). One of these previously undescribed species, Chetia mola, is discussed. The probable reasons for the richness and for the discontinuous fish assemblages are discussed. (Baker-IVI)
W84-03894

INFLUENCE OF CERTAIN ENVIRONMENTAL FACTORS ON THE PREDATORY EFFICIENCY OF THE LARVIVOROUS FISH MACROPODUS CUPANUS,
Kerala Univ., Trivandrum (India). Dept. of Aquatic Biology and Fisheries.
S. S. Jacob, N. B. Nair, and N. K. Balasubramanian.
Environmental Biology of Fishes, Vol. 9, No. 3/4, p 295-300, 1983. 4 Fig, 4 Tab, 29 Ref.

Descriptors: *Fish behavior, *Predation, Feeding rates, Alternative planning, Mosquitoes, Biocontrol, Fish diets, Fish food organisms.

Investigations of the effect of certain environmental factors on predatory efficiency of the indigenous larvivorous fish Macropodus cupanus indicates the dependence, in a quantifiable way, of predation on the environmental complex surrounding the prey-predator system. Prey consumption is less at low temperatures and increases significantly with rise in temperature. Feeding under conditions of light is significantly higher than in darkness. Salinities of up to 21.83% do not affect predation rate, except that owing to stress conditions, prey intake at 21.83% is lower than at 0.12%. Consider-

ing fish size, in terms of unit body weight, predation declines significantly as size increases. However, when total body weight is considered, predation increases with increase in fish size. Environmental factors do not alter the time course of predation regularly or significantly, perhaps owing to haphazard intake subsequent to satiation and/or a 'learning' factor. The higher predation rate of this fish when compared to the conventional larvivore Gambusia affinis indicates its potential as a biocontrol agent of mosquito larvae. (Author's abstract)
W84-03896

CHARACTERISTICS OF A GENERAL MATHEMATICAL MODEL OF WATER-QUALITY MANAGEMENT IN LARGE RESERVOIRS,
Yu. S. Vasil'ev, G. V. Simakov, and A.I. Al'khimenko.
Hydrotechnical Construction, Vol. 17, No. 8, p 432-434, August, 1983. 4 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 8, p 36-37, August, 1983.

Descriptors: *Water quality, *Reservoirs, *Mathematical models, Stochastic process, Reservoir management, Water quality control, Prediction.

A model is sought which will permit predicting the water quality of a reservoir as a function of the concentration of pollutants in the water body both in space and in time. The synthesis of analytical solutions to the problem with results obtained from both prototype and laboratory experimental investigations is the most promising when constructing a general mathematical model of water quality management. It is expedient to compare the existing particular mathematical models oriented towards third- and fourth-generation computers. The occurrence of wind and its parameters must be considered as random variables. Wave parameters are also random variables. It is natural thus that the distribution of pollutant concentrations should be evaluated on the basis of a stochastic approach. In turn the refined mathematical model will make it possible to establish operating regimes of outlets corresponding to reality and to use more completely the self-purifying capacity of a water body. (Baker-IVI)
W84-03912

NITROGEN LOSS FROM FRESHWATER AND SALINE ESTUARINE SEDIMENTS,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
C. J. Smith, and R. D. De Laune.
Journal of Environmental Quality, Vol. 12, No. 4, p 514-518, 1983. 4 Fig, 1 Tab, 25 Ref.

Descriptors: *Denitrification, *Estuaries, *Sediments, Nitrification, Nitrogen cycle, Nitrogen balance, Nitrogen compounds, Chemical properties.

The predominant inorganic N species present in estuarine sediments is NH4(+). This ion is stable under anaerobic conditions, but in environments that have both aerobic and anaerobic zones, NH4(+)-N can be lost. The magnitude of ammonium-N (NH4+-N) loss from nitrification-denitrification reactions in bottom sediments collected from saline and freshwater Louisiana Gulf Coast lakes was determined. Studies were collected in the laboratory and field. Maximum gaseous N accumulation, from fresh-water and saline sediment amended with 4.5 microg nitrate-N (NO3(-)N)/g (on dry-wt basis), was 1.6 and 1.4 microg N/g, respectively. The addition of 50 microg NH4(+)-N/g stimulated the evolution of N2O from both sediments, and represents 0.02 and 0.2% of the NH4(+)-N applied to the saline and fresh sediment, respectively. Nitrous oxide (N2O) emissions measured in the field were low. The annual N2O emission was 10 and 34 mg N/sq m from the saline and freshwater lakes. These values agree closely with the N2O emission rates calculated from laboratory data. Denitrification was also estimated from NH4(+)-N amended sediment using the acetylene (C2H2) inhibition technique and N-15 balance. Recovery of N-15 decreased rapidly during the 0- to 8-week period when high denitrification rates were measured. The denitrification rate estimated from N-15 recovery during the 0- to 8-week period was 3.7 mg N/sq m/d for each sediment. Approximately 50% of the added N-15 was lost, an amount equivalent to 1.4 g N/sq m/y. As the added N-15H4(+)-N was incorporated into the organic N pool, little or no further N-15 was lost. (Murphy-IVI)
W84-03929

FATE OF OXYGEN AND REFRACTORY ORGANICS IN MARMOT BASIN STREAMS: SEASONAL VARIATIONS,
Inland Waters Directorate, Ottawa (Ontario).
S. A. Telang, and G. W. Hodgson.
Journal of Environmental Quality, Vol. 12, No. 4, p 575-579, 1983. 1 Fig, 6 Tab, 13 Ref.

Descriptors: *Oxygen, *Organic compounds, *Marmot Basin, Total organic carbon, Chemical oxygen demand, Biological oxygen demand, Dissolved oxygen, Fulvic acids, Humic acids, Tannins, Lignins, Stream degradation, Alberta, Canada.

A conceptual process reactor model with input-output functions developed for the mountain streams of the Marmot Basin (Alberta, Canada) showed seasonal trends in the conversion of organic matter. Based on mass balance data, organic compounds (e.g., tannins and lignins), and total organic C showed net gains in the stream waters in winter; in spring, the compounds tend to be depleted in waters; in the fall, humics and tannins and lignins underwent net depletion. The indicated changes of accumulation and depletion ranged from +95 to -42% of incoming mass. The chemical O2 demand showed gains in the stream waters throughout the season. The biological O2 demand showed little change throughout the seasons. Photochemical processes appeared to be important processes in the conversion of organic matter in clear, cold mountain streams of the Marmot Basin. Biological uptake of refractory compounds appeared to be a minor process. (Author's abstract)
W84-03933

ECOLOGICAL SEASONAL CYCLES IN A COLORADO MOUNTAIN POND,
Colorado Univ. at Boulder. Dept. of Environmental, Population, and Organismic Biology.
P. M. Ellsworth.
Journal of Freshwater Ecology, Vol. 2, No. 3, p 225-237, December, 1983. 2 Fig. 46, Ref.

Descriptors: *Zooplankton, *Ponds, *Seasonal variations, Mountains, Population dynamics, Dissolved solids, Alkalinity, Conductivity, Limnology.

A permanent point at 3100 meters elevation was studied for an entire year to monitor zooplankton populations as they changed seasonally and associate those changes with biotic and abiotic factors. Conductivity, alkalinity, and dissolved solids were low during the summer but increased dramatically in the winter due to freezing out. Chlorophyll measurements indicated that phytoplankton reached its population maximum during the winter. The summer zooplankton community was dominated by the cladocerans, Holopedium gibberum and Daphnia rosea; the copepod, Diaptomus leptopus; the rotifers, Keratella cochlearis, Conochilus unicornis, and Polyarthra dolichoptera; and Chaoborus larvae. D. rosea disappeared from the plankton in August, possibly due to a combination of predation and competition. All limnetic Crustacea disappeared during ice cover, leaving rotifers as the most successful winter plankters. The posterior spine of K. cochlearis was long in the summer, and short or absent in the winter. This seasonal change in morphology may be a means of reducing mortality due to predation. (Baker-IVI)
W84-03956

BENTHIC MACROINVERTEBRATES OF SELECTED HABITATS OF THE LOWER MISSISSIPPI RIVER,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
D. C. Beckett, C. R. Bingham, and L. G. Sanders.
Journal of Freshwater Ecology, Vol. 2, No. 3, p 247-261, December, 1983. 3 Fig, 3 Tab, 32 Ref.

Descriptors: *Macroinvertebrates, *Mississippi River, *Invertebrates, Benthic environment, Flow, Flow characteristics, Water currents, Velocity, Substrate.

The distribution of benthic macroinvertebrates was studied in four aquatic habitat types in the lower Mississippi River: dike fields, a natural bank, a secondary channel, and an abandoned channel over a high flow, two moderate, and two low flow periods. Only minor changes in composition over the various flow regimes were displayed by the biotas present in the natural bank, the secondary channel, and the abandoned channel. The natural bank was consistently dominated by the burrowing mayflies Tortopus incertus and Pentagenia vittigera and hydropsychid caddisflies; the consistently most common taxa in the secondary channel were the sand-dwelling chironomids Robackia claviger and Chernovskiia orbicus; phantom midges, tubificid oligochaetes, and fingernail clams were always the most abundant macroinvertebrates in the abandoned channel. The dike fields, however, showed large changes in biotic composition over the different flow regimes. These compositional changes correlated with changes in river stage and resultant alterations in current and substrate. The distribution of macroinvertebrates in the lower Mississippi River appears to be a function of the physical characteristics of the system, notably current velocity and substrate composition. (Baker-IVI)
W84-03957

COMPARISON OF MULTIPLATE AND SURBER SAMPLERS IN A COLORADO MOUNTAIN STREAM,
Chadwick and Associates, Littleton, CO.
For primary bibliographic entry see Field 7A.
W84-03958

MEASURED AND PREDICTED FLUXES OF BIOGENIC SILICA IN LAKE MICHIGAN,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
C. L. Schelske, B. J. Eadie, and G. L. Krausse.
Limnology and Oceanography, Vol. 29, No. 1, p 99-110, January, 1984. 4 Fig, 3 Tab, 31 Ref. EPA grants R-806294 and R-804503.

Descriptors: *Lakes, *Silica, *Lake Michigan, Great Lakes, Seasonal variations, Sediments, Chemical analysis, Diatoms, Biogenic silica.

Because of excess phosphorus inputs, epilimnetic diatom production in Lake Michigan is limited by available supplies of silica during summer stratification. Biogenic silica fluxes obtained from sediment trap collections in the offshore waters of Lake Michigan were compared with fluxes predicted from the silica disappearance model. Measured and predicted fluxes were in good agreement for offshore stations, but at stations closer to shore measured fluxes were 2-3 times greater than predicted fluxes. Little of the diatom production was dissolved in the water column as demonstrated by sediment trap and water chemistry data. Greater than predicted fluxes must occur therefore at nearshore locations and these were attributed to new silica supplied from upwellings, tributary inputs, and recycling and resuspension in nearshore sediments. The good agreement between measured and predicted fluxes in offshore waters shows that biogenic silica fluxes may be used to determine the collecting efficiency of sediment traps. (Baker-IVI)
W84-03963

PREDICTION OF INTERNAL PHOSPHORUS LOAD IN LAKES WITH ANOXIC HYPOLIMNIA,
McGill Univ., Montreal (Quebec). Dept. of Biology.
G. K. Nurnberg.
Limnology and Oceanograpy, Vol. 29, No. 1, p 111-124, January, 1984. 4 Fig, 7 Tab, 61 Ref.

Descriptors: *Model studies, *Lakes, *Phosphorus load, *Hypolimnion, *Anoxic conditions, Nutrients, Eutrophication, Prediction, Phosphorus retention.

Two models are given to predict internal phosphorus load in lakes with anoxic hypolimnia. The first predicts internal load as the difference between the observed phosphorus retention in anoxic lakes and that predicted by a formula that adequately describes phosphorus retention in anoxic lakes. The second model predicts internal load as the product of an average rate of phosphorus release from anoxic sediments, the surface area of the anoxic sediment, and the period of anoxia. Predictions of the first model compare favorably with 17 observed values of internal load. These models suggest that mean phosphorus concentration in anoxic lakes can be predicted in two ways. One can use whole-lake phosphorus budget models which implicitly incorporate internal phosphorus load, because they include a measurement of phosphorus retention. Alternatively, a term to account for the internal load can be added to current models based on external load and predicted retention. (Baker-IVI)
W84-03964

ORIGIN OF A METALIMNETIC CHRYSOPHYTE PEAK,
Scarborough Coll., Westhill (Ontario).
F. R. Pick, C. Nalewajko, and D. R. S. Lean.
Limnology and Oceanography, Vol. 29, No. 1, p 125-134, January, 1984. 5 Fig, 1 Tab, 34 Ref.

Descriptors: *Lakes, *Chrysophyta, *Chlorophyll, *Jacks Lake, *Ontario, Algal growth, Eutrophication, Metalimnion, Chrysosphaerelia, Excystment.

A metalimnetic chlorophyll peak in Jacks Lake, Ontario, was due mainly to a colonial chrysophyte, Chrysosphaerella longispina. The peak did not result from an in situ growth, nor a passive and progressive accumulation of epilimnetic cells. Rather, a sudden bloom of the algae occurred in the epilimnion at the end of June, due to excystment. This bloom then descended rapidly and after no more than 4 days, it was concentrated in a narrow band below the thermocline. No net increase was observed in chlorophyll a or cell biomass with time once the population was established in this region. No dividing cells were observed. After about 2 weeks the chlorophyll a concentration at the peak started to decline and the peak disappeared by the end of August. The measurement of chlorophyll a greatly exaggerated the importance of metalimnetic peaks. (Baker-IVI)
W84-03965

EFFECT OF THE ASIATIC CLAM, CORBICULA FLUMINEA, ON PHYTOPLANKTON OF THE POTOMAC RIVER, MARYLAND,
Geological Survey, Reston, VA.
R. R. H. Cohen, P. V. Dresler, E. J. P. Phillips, and R. L. Cory.
Limnology and Oceanograpy, Vol. 29, No. 1, p 170-180, January, 1984. 9 Fig, 4 Tab, 33 Ref.

Descriptors: *Rivers, *Phytoplankton, Population dynamics, Potomac River, Clams, Tidal rivers.

The freshwater, tidal Potomac River has produced high concentrations of phytoplankton during every July-September low flow period of the 1960's and 1970's, but in the summers of 1980 and 1981 phytoplankton abundance between Rosier Bluff and Hatton Point was 40-60% lower than that upstream and downstream. In 1980 and 1981 the highest biomass of the Asiatic clam, Corbicula fluminea, was in the same reach as the phytoplankton abundance 'sag.' The volume of the sag reach could be pumped through the Corbicula population in 3-4 days as indicated by filtration rates. Corbicula removed 30% of the phytoplankton chlorophyll a from a river water sample in 2 hr. Pheophytin a in surficial sediments correlated well with clam biomass as a consequence of phytoplankton excreted in pseudofeces. The theories that peak discharge, zooplankton, toxic substances, and nutrient limitation induced the sag were not supported. (Baker-IVI)
W84-03966

24-H CHANGES IN CHLOROPHYLL CONTENT OF PHYTOPLANKTON OF LAKE JELONEK, AS COMPARED WITH THE PHYSICAL AND CHEMICAL PROPERTIES OF WATER,
Poznan Technical Univ. (Poland). Inst of Environmental Engineering.
For primary bibliographic entry see Field 5C.
W84-03988

FULL DIURNAL OBSERVATIONS ON CHANGES IN APHANIZOMENON FLOS-AQUAE (L.) RALFS ON THE BACKGROUND OF PHYSICO-CHEMICAL CONDITIONS IN LAKE SWIETOKRZYSKIE DURING THE 1980 SUMMER PERIOD,
Adam Mickiewicz Univ., Poznan (Poland). Dept. of Hydrology.
L. Burchardt, and J. Panczakowa.
Polskie Archiwum Hydrobiologii, Vol. 30, No. 3, p 229-246, 1983. 11 Fig, Tab, 28 Ref.

Descriptors: *Lakes, *Algae, *Chlorophyll, *Aphanizomenon, *Lake Swietokrzyskie, *Poland, *Diurnal variation, Seasonal variations, Nitrogen, Phosphorus, Nutrients, Eutrophication, Acidity, Dissolved oxygen, Biochemical oxygen demand.

Full diurnal algaelogic and physicochemical investigations carried out in July and August 1980 at various stages of Aphanizomenon flos-aquae blooming showed maximum numbers of Aphanizomenon flos-aquae individuals occurred in July at 21 hours and in September at 18 hours. Maximal chlorophyll c content, pH, dissolved oxygen, BOD5, and oxygen consumption occurred at the same hours. Wind direction and its force were the factors deciding the density of Aphanizomenon flos-aquae individuals in the surface water layer of Lake Swietokrzyskie (Poland). The high level of biogens in the water body resulted from the fact that no distinct differences in the value of these compounds was observed over a 124 hr period notwithstanding considerable fluctuations in the numbers of Aphanizomenon flos-aquae trichomes. Larger amounts of chlorophyll a were noted during the afternoon hours in the cells of Aphanizomenon flos-aquae from samples taken at a depth of 5.0 to 5.5 m than from the surface. It appears that for proper distinction of the processes taking place between microorganisms and the water environment full diurnal investigations will be needed at periods most critical to the water body. Maximal values for numbers of algae individuals, dissolved oxygen, BOD5, oxygen consumption and pH occurring in July and August at 21.00 and 18.00 hours indicate that these hours are the most suitable for studies aimed at evaluating the intensiveness of changes taking place in a water body during a day. (Baker-IVI)
W84-03989

SOURCES AND MOLECULAR WEIGHT OF 'DISSOLVED' ORGANIC CARBON IN AN OLIGOTROPHIC LAKE,
Marine Biological Lab., Woods Hole, MA. Ecosystems Center.
J. J. Cole, W. H. McDowell, and G. E. Likens.
OIKOS, Vol. 42, No. 1, p 1-9, January, 1984. 4 Fig, 3 Tab, 42 Ref.

Descriptors: *Dissolved solids, *Organic carbon, *Oligotrophic lakes, *Mirror Lake, *New Hampshire, Molecular weight, Water pollution sources, Ultrafiltration, Precipitation, Soil solution, Algal growth, Decomposition, Residence time.

Ultrafiltration was used to try to determine the origin of dissolved organic carbon (DOC) in Mirror Lake, New Hampshire. The distribution of molecular weights of DOC was relatively constant with depth and season, with a predominance of high-molecular weight (>100,000 daltons; 31%) and moderate-molecular weight compounds (1,000 to 10,000 daltons; 36%). The distribution of molecular weights of DOC in the lake was distinctly different from that of the DOC which entered the lake in stream water, soil solution, or precipitation. Lake water is relatively enriched in DOC above 100,000 daltons; this high-molecular weight DOC is apparently produced within the lake. One autochthonous source of DOC above 100,000 daltons is that produced during algal growth and decomposition. An input/output budget of the DOC for each molecular weight class suggested that most of the DOC in the lake resides in the lake for several years. (Author's abstract)
W84-04053

RIVER EPILITHON: TOWARD A STRUCTURAL-FUNCTIONAL MODEL,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
M. A. Lock, R. R. Wallace, J. W. Costerton, R. M. Ventullo, and S. E. Charlton.
OIKOS, Vol. 42, No. 1, p 10-22, January, 1984. 5 Fig, 3 Tab, 68 Ref.

Descriptors: *Rivers, *Epilithon, *Microorganisms, Diatoms, Blue-green algae, Invertebrates, Algae, Bacteria, Glycocalyx, Photosynthesis, Running waters.

Granite and epoxy resin substrates anchored in the Muskeg and Steepbank rivers (Alberta) were used to sample the epilithon. A vigorous epilithon develops both on the upper and lower surfaces of the rock and plastic substrates in these boreal rivers. The epilithic community is usually much more extensive on the upper surface; however, the epilithon on the lower surface is sometimes equally well developed and often contains large numbers of chlorophyll-containing microorganisms (both blue-green algae and diatoms). Morphological evidence suggests grazing of the epilithon by invertebrates, and clearly shows that the cellular components of this sessile community grow in distinct microcolonies within a continuous fibrous anionic matrix composed of bacterial and algal glycocalyces. The theoretical ramifications of this demonstration of a complex epilithon, in the context of bacterial digestive processes, nitrogen cycling, metal sorption, and the flux of organic matter in the stream ecosystem analyzed in terms of a structural-functional hypothetical model of the epilithon. Although algae and their associated photosynthetic capacity may at times apparently dominate the epilithon, there may be equally inportant system roles associated with the substantial heterotrophic community. Also the epilithon is a major element in running water light and organic energy transactions because of its optimum position for photosynthetic processes in many rivers and its optimum position for capturing organic energy from the overlying water. (Moore-IVI)
W84-04054

LEAF PROCESSING CAPABILITIES OF AQUATIC HYPHOMYCETES: INTERSPECIFIC DIFFERENCES AND INFLUENCE ON SHREDDER FEEDING PREFERENCES,
New Mexico State Univ., Las Cruces. Dept. of Biology.
T. L. Arsuffi, and K. Suberkropp.
OIKOS, Vol. 42, No. 2, p 144-154, January, 1984. 7 Fig, 5 Tab, 27 Ref. NSF grant DEB 7922997.

Descriptors: *Detritus, *Hyphomycetes, *Leaves, *Feeding, *Caddisflies, Decomposition, Streams, Aquatic life.

Litter inputs from the surrounding terrestrial vegetation comprise a potentially important nutrient and energy base in streams. Macroinvertebrate detritivores rely on this material as an important component of their diets, but in its original form, leaf detritus is an unsuitable food source. Leaf litter is converted by microbial activity into a more palatable and nutritional food source. Degradative abilities of aquatic hyphomycetes and the relationship between fungal-mediated conditioning of aspen leaves and feeding responses of caddisfly (Trichoptera) detritivores were examined. Interactive effects of conditioning time and fungal species were determined by conducting preference experiments in separate enclosures with all treatments (conditioning times and fungal species) or each conditioning time with all fungi. Preferences were established by comparison of leaf consumption among various treatments. Interspecific differencs among fungi in their physical-chemical modifica-

tion of aspen leaves were primarily rate-related. For three fungi, preferences exhibited by larvae were not accounted for by either the fungal species or conditioning time alone, but rather, their interaction. The most palatable leaves were those colonized with these fungi at times subsequent to the appearance of detectable pectin lyase activity. At these times, leaves were initially softened, exhibited substantial weight loss and almost doubled their nitrogen content in comparison to uninoculated leaves. Leaves colonized by one fungal species were unpalatable regardless of the degree of conditioning. (Moore-IVI)
W84-04055

GROWTH LIMITING FACTORS FOR OSCILLATORIA AGARDHII AND DIATOMS IN EUTROPHIC LAKES,
Oslo Univ. (Norway). Dept. of Limnology.
O. Lovstad.
OIKOS, Vol. 42, No. 1, p 185-192, January, 1984. 6 Fig, 1 Tab, 38 Ref.

Descriptors: *Oscillatoria, *Diatoms, *Eutrophic lakes, *Growth, Phosphorus, Silica, Limiting nutrients, Trace metals, Chelators.

Laboratory batch experiments were carried out to determine growth limiting nutrients and the degree of growth limitation for some diatoms and red and green forms of Oscillatoria agardhii Gom. Water samples from three lakes with average limnetic total phosphorus concentrations from 15 to 200 microg P/l were analysed. With the exception of Stephanodiscus hantzschii Grun all the diatoms investigated became growth limited at very low SRP or phosphate concentrations. Asterionella formosa Hass, probably grows more efficiently at low concentrations of phosphate than Synedra cf. acus Kutz. and Fragilaria crotonensis Kitt., but was competitively displaced at high pH levels (> 9). Stephanodiscus competitively displaced the other diatoms at low molar Si:P ratios, i.e. less than 10. Oscillatoria grew better at very high pH levels (> 10) than the diatoms. Addition of phosphate and chelated iron (FeEDTA) singly or in combination was, however, often necessary to increase the growth rate of Oscillatoria under nutrient limiting conditions. This indicates that both external concentrations of phosphate or some trace metals or chelators have to increase to above some threshold level at least during parts of the year, if Oscillatoria shall become dominant. Results of the experiment indicate that SRP and SRSi concentrations measured chemically may be similar to the available concentrations of phosphate and silicate respectively. (Author's abstract)
W84-04056

DECOMPOSITION OF PLANKTONIC ALGAE IN AN OLIGOTROPHIC LAKE,
02750e Biological Lab., Woods Hole, MA.
J. J. Cole, G. E. Likens, and J. E. Hobbie.
OIKOS, Vol. 42, No. 3, p 257-266, March, 1984. 7 Fig, 1 Tab, 36 Ref.

Descriptors: *Oligotrophic lakes, *Decomposition, *Algae, *Plankton, *Mirror Lake, *New Hampshire, Incubation, Particulates, Carbon dioxide, Metabolism, Bacteria.

A new procedure (dip incubation) was used to measure both the dissolution and mineralization (to CO2) of killed C-14 labelled phytoplankton in an oligotrophic lake. This procedure, based on a series of 24-h incubations in bottles, avoids the problem of extremely long incubations and can be used to measure, independently, the dissolution and mineralization rates of algal detritus of any recent age. In Mirror Lake, New Hampshire, the conversion of particulate carbon to CO2 occurred only in the presence of living microorganisms and was strongly influenced by the age of the algal detritus and the water temperature. There was a pronounced annual cycle of the conversion of particulates to CO2 with highest rates (average rate for 6 d of 6%/d) during summer and lowest rates (average rate for 6 d of 0.5%/d) in winter. In comparison to these average rates, the initial rates of both dissolution and mineralization were higher and much less dependent upon temperature. These initial rates, taken alone, would give an erroneously high estimate of the rate of decomposition and underestimate the importance of temperature as a factor controlling decomposition. We used an annual cycle of these measurements in conjunction with models of the age structure of particulate detritus to estimate the metabolism of algal C by planktonic microbes. Our estimate (3.6 to 4.3 micro g C/l/d) is comparable to previous measurements of total microbial respiration (of all C-sources) in both amount (3.1 micro g C/l/d) and annual pattern. This comparison suggests that algal carbon is a major C-source for planktonic bacteria in the epilimnion of Mirror Lake. (Author's abstract)
W84-04057

VARIATIONS IN THE LEVEL OF LAKE MALAWI,
University Coll., Cardiff (Wales). Dept. of Civil and Structural Engineering.
R. S. Drayton.
Hydrological Sciences Journal, Vol. 29, No. 1, p 1-12, 1984. 5 Fig, 3 Tab, 8 Ref.

Descriptors: *Water level, *Lake Malawi, Africa, Precipitation, Rainfall, Runoff, Outflow, Water balance.

Lake Malawi is the third largest lake in Africa, with an area of 28,750 sq km. Throughout this century, the water level of Lake Malawi has varied widely. During the period 1976-1980, this level rose dramatically. The causes of these changes were investigated using Monte Carlo techniques and equations based on the water balance of the lake. The model study showed that as increase in average rainfall equal to that recorded between 1915 and 1937, and between 1940 and 1979, is sufficient to have caused to recorded rise in average lake level over those periods. Changing the runoff rates in the model showed that small increases in the rate of runoff would make a significant contribution to rising lake levels. The exceptional rises of level in recent years can be attributed to the very much increased amount of freewater available to the system. This excess of freewater resulted from the very high rainfall over the lake itself, and to a lesser degree from high inflow. The high inflow resulted from above-average rainfall over the land. Man-made changes in runoff and outflow have been relatively unimportant. (Baker-IVI)
W84-04066

TECHNIQUES FOR DETECTING TRENDS IN LAKE WATER QUALITY,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
R. H. Montgomery, and K. H. Reckhow.
Water Resources Bulletin, Vol. 20, No. 1, p 43-52, February, 1984. 1 Fig, 3 Tab, 49 Ref. NOAA grant 03-78-B01-109.

Descriptors: *Lakes, *Water quality, *Trends, Statistical methods, Autocorrelation, Data analysis.

Information on changes in water quality over time is important for water quality management. The use of statistical techniques to detect trends in water quality parameters has the potential to provide the quantitative information needed for water resources management and planning decisions. A trend detection method is presented that provides: hypothesis formulation, the statement of the problem to be tested; data preparation, the selection of water quality variable and data; data analysis, the exploratory data analysis techniques; and statistical test, the tests for detecting trends. The starting point for the use of trend detection techniques is the determination of water quality characteristics upon which proper management and planning decisons are to be based. These characteristics determine the variables and data chosen, and the formulation of the null and alternative hypotheses. The frequent presence of autocorrelation in lake data prohibits straightforward use of most statistical techniques, including regression, based on the violation of the independence assumption. The statistical tests for dependent data are suggested for use, almost exclusively, when dealing with lake systems. The method is utilized in a stepwise fashion and is presented in a nonstatistical manner to allow use by those not well versed in statistical theory. (Moore-IVI)
W84-04103

CHEMICAL COMPOSITION OF SOFTWATER FLORIDA LAKES AND THEIR SENSITIVITY TO ACID PRECIPITATION,
Environmental Science and Engineering, Inc., Gainesville, FL.
C. D. Hendry, and P. L. Brezonik.
Water Resources Bulletin, Vol. 20, No. 1, p 75-86, February, 1984. 8 Fig, 5 Tab, 48 Ref. EPA grant 805560.

Descriptors: *Florida, *Softwater lakes, *Acid rain, Aluminum, Nutrients, Chlorophyll a, Hydrogen ion concentration, Alkalinity, Sulfates, Acidification, Lakes.

Based on alkalinity data for 596 lakes, 31% of Florida's 7300 lakes have < 100 micro eq/L alkalinity and are sensitive to acid deposition. More than two-thirds of the lakes in 12 northern Florida counties fit this criterion. Increasing aluminum and decreasing nutrient and chlorophyll a concentrations were observed with decreasing pH in a survey of 20 softwater lakes. Maximum measured aluminum values (100-500 micro g/L) are below levels associated with fish toxicity. Factor analysis showed that lake chemistry was related to three principal factors, representing three major processes: watershed weathering, acidification, and nutrient inputs. An acidification index defined as the difference between excess SO4(2-) and excess (Ca(2+) + Mg(2+)) accounted for 74% of the variance in lake pH. Comparison of historical (late 1950s) and present data for pH, alkalinity, and excess SO4(2-) indicated loss of alkalinity (> 25 micro eq/L) and increases in excess SO4(2-) (16-34 micro eq/L) in several softwater lakes. (Author's abstract)
W84-04107

DYNAMICS OF ADDED NITRATE AND PHOSPHATE COMPARED IN A NORTHERN CALIFORNIA WOODLAND STREAM,
William Paterson Coll. of New Jersey, Wayne. Dept. of Biology.
M. J. Sebetich, V. C. Kennedy, S. M. Zand, R. J. Avanzino, and G. W. Zellweger.
Water Resources Bulletin, Vol. 20, No. 1, p 93-101, February, 1984. 5 Fig, 1 Tab, 44 Ref.

Descriptors: *Nitrates, *Phosphates, *Little Lost Man Creek, *California, Cycling nutrients, Dispersion, Streams, Biota, Sediments.

Injections of NO3 and PO4 were made during September 1975 into Little Lost Man Creek, a small pristine stream in Redwood National Park, California. Chloride, a conservative constituent, was added in a known ratio to the nutrients. Nutrient loss at a downstream point was calculated using concentration of added Cl as a reference. Nitrate nitrogen (NO3-N), added for 4 h, reached 920 micro g/l (above 5 micro g/l background) just below the injection point, but increased only to 405 micro g/l at 310 m downstream. The concentration decrease was attributed to dispersion and to uptake by stream biota. Percent of NO3-N lost decreased with increasing concentration of NO3-N. Phosphate phosphorus (PO4-P) was added a week after the NO3-N for 3 h, causing a concentration increase of 296 micro g/l (above 13 micro g/l background) just below the injection point, of 161 micro g/l at 90 m downstream, and of 98 micro g/l at 310 m. Percent loss of PO4-P at downstream sites increased with increasing PO4-P concentration and also for a short period after peak concentration occurred, but then decreased as PO4-P concentration continued decreasing. Differences in stream response to added NO3-N and PO4-P are attributed to differing rates of reaction with biota and differing degrees of interaction with abiotic stream solids. (Author's abstract)
W84-04109

WATERBORNE NUTRIENT BUDGETS FOR THE RIPARIAN ZONE OF AN AGRICULTURAL WATERSHED,
Georgia Univ., Athens. Inst. of Ecology.
R. R. Lowrance, R. L. Todd, and L. E. Asmussen.
Agriculture, Ecosystems and Environment, Vol. 10, No. 4, p 371-384, December, 1983. 4 Fig, 4 Tab, 26 Ref. NSF grants DEB 78-10841 and DEB 82-07210.

Descriptors: *Forests, *Agricultural watersheds, *Nutrients, *Riparian vegetation, Nitrogen, Phosphorus, Calcium, Magnesium, Land management, Groundwater, Precipitation, Land use, Cropland.

Agroecosystems in the southeastern United States Coastal Plain typically have uplands in agriculture with mixed hardwood forests along the stream channels. This study determined the inputs and outputs of waterborne nutrients for the riparian forest ecosystem of an agricultural watershed. Quantities of phreatic groundwater and precipitation nutrient inputs and phreatic and surface nutrient outputs were determined during 1979. Based on input/output budgets, these streamside forests were shown to be effective in retaining N, P, Ca, and Mg. Partial conversion of the riparian forest to cropland was projected to increase NO3-N and NH4-N loads by up to 800%. Total replacement of riparian forest with crops would increase loads of all nutrients studied except organic N, DMRP, and total P. Land managers can maintain the nutrient filtering capacity of the streamside forest by selective harvesting of hardwoods and by maintaining the present hydrologic regime. (Author's abstract)
W84-04114

STRUCTURE AND ANNUAL BIOMASS PRODUCTION OF NYMPHOIDES PELTATA (GMEL.) O. KUNTZE (MENYANTHACEAE),
Katholieke Univ., Nijmegen (Netherlands). Lab. of Aquatic Ecology.
Th. C. M. Brock, G. H. P. Arts, I. L. M. Goossen, and A. H. M. Rutenfrans.
Aquatic Botany, Vol. 17, No. 3/4, p 167-188, December, 1983. 4 Fig, 6 Tab, 39 Ref.

Descriptors: *Nymphoides, *Biomass, *Aquatic plants, *Bemmelse Strang, *Netherlands, Cycling nutrients, Oxbow lakes, Seasonal variation, Submerged plants.

In shallow backwater of the river Waal (Netherlands), the floating leaved macrophyte Nymphoides peltata is common and often represents the dominant vegetation. In 1980 and 1981, the structure and aspects of production, consumption, decomposition, and nutrient cycling of N. peltata were studied quantitatively the the Bemmelse Strang, an oxbow lake of the river Waal. The seasonal changes in the vertical stratification of the biomass were studied in concrete tanks. These seasonal changes were studied with the harvest method, while the estimation of the net primary production was based upon biomass data and turnover rates of various plant parts. The morphological differentiation of N. peltata into roots, short shoots, long shoots, petioles, leaf blades and flowering structures offers a variety of habitats for the accompanying organisms. An important function of N. peltata is the supply of substrates for periphytic organisms. The data are compared with those of other water plants, especially other floating-leaved macrophytes. The maximum submerged surface area supplied by N. peltata in the Bemmelse Strang is intermediate between those reported for emergent and submerged macrophytes. In 1980, N. peltata reached its peak biomass in August being 372 g AFDW/sq m (ash-free dry weight). The annual net productivity of Nymphoides was estimated to be 1036 g AFDW/sq m. The leaf blades and their petioles contributed most to the production. (Moore-IVI)
W84-04115

FACTORS AFFECTING NITROGENASE ACTIVITY ASSOCIATED WITH MARSH GRASSES AND THEIR SOILS FROM EUTROPHIC LAKES,
Dundee Univ. (Scotland). Dept. of Biological Sciences.
M. T. Ogan.
Aquatic Botany, Vol. 17, No. 3/4, p 215-230, December, 1983. 6 Fig, 3 Tab, 28 Ref.

Descriptors: *Grasses, *Nitrogenase, *Soil water, *Eutrophic lakes, Nitrogen, Phosphorus, Phalaris, Phragmites, Temperature, Sunlight, Marshes, Diurnal variation.

The acetylene reduction activity (ARA) of soil-plant cores and intact, soil-free plant-root systems was used to study the influence of soil moisture content, diurnal cycles of temperature and light, and inorganic N and P on the nitrogenase activity (AR) associated with Phalaris arundinacea L. and Phragmites australis (Cav.) Trin. from two eutrophic lakes (lochs), Balgavies and Forfar. A positive correlation ($r = 0.81$, $n = 26$) was established between AR and soil moisture content in individual soil-plant cores of Phalaris from Forfar Loch. Nitrogenase activity, soil moisture and NO2(-)-N increased with decreasing distance from lake water in Balgavies Loch. Diurnal fluctuations in AR, probably attributable to a combined effect of soil temperature and illumination changes, were observed under field conditions for Phalaris and Phragmites. Under laboratory conditions, the shading and cutting of Phalaris shoots did not inhibit ARA, which suggested that new photosynthates did not necessarily supply substrate for activity in the short term. Partial and temporary inhibition of ARA was obtained in dissected soil-plant cores after a single application of NH4(+)-N and NO3(-)-N (350 micro g N/g fresh weight). At concentrations equivalent to 300 micro g P/g fresh weight of Phalaris cores, PO4(3-)-P also caused partial and temporary inhibition of ARA of soil-free plant-root systems, but stimulated activity in intact simulated in situ systems. (Author's abstract)
W84-04116

PHYTOSOCIOLOGICAL STUDY OF THE MACROPHYTIC VEGETATION OF RUNNING WATERS IN WESTERN LOWER SAXONY (FEDERAL REPUBLIC OF GERMANY),
Oldenburg Univ. (Germany, F.R.). Dept. of Biology.
G. Wiegleb.
Aquatic Botany, Vol. 17, No. 3/4, p 251-274, December, 1983. 2 Fig, 3 Tab, 77 Ref.

Descriptors: *Macrophytes, *Rivers, *Western Lower Saxony, *West Germany, Vegetation, Aquatic plants, Plant communities.

A survey was carried out of the macrophytic vegetation in running waters of Western Lower Saxony. Three hundred and eighty-two phytosociological relevees were classified by common table work to 30 vegetation types of different phytosociological validity. The vegetation types are described and floristically characterized. Most of them belong to the complex Sparganium emersum community, which is characterized by the dominant occurrence of the nymphaeid species Sparganium emersum Rehm., Nuphar lutea (L.) Sm., Sagittaria sagittifolia L. and Potamogeton natans L., but magnopotamid-, parvo-potamid-, batrachiid- and pleustophyte-dominated communities also occur. Similarity between the different vegetation types was checked by multivariate techniques, one classification technique (minimum variance clustering) and one ordination techniques (principal components analysis). Additionally, syndynamical relations between the types were studied by observing the vegetation changes of 46 sample points within 2 years. The relations between different vegetation types are shown by combination of the different approaches. Finally, some more general statements are made regarding the handling of such data sets, as well as the consequences of the results for the classification of macrophytic vegetation in Central European rivers. (Author's abstract)
W84-04117

TESTS FOR EVALUATING THE STATUS OF ECOSYSTEMS OF FRESH WATER LAKES WITH MULTIPLE USE,
Moscow State Univ. (USSR).
A. S. Konstantinov.
Hydrobiological Journal, Vol. 19, No. 1, p 1-10, 1983. 2 Fig, 31 Ref.

Descriptors: *Ecosystems, *Lakes, Energy, Reviews, Aquatic life, Hydrobiology.

Tests for evaluating aquatic ecosystems as elements of the biosphere are discussed. The tests are based on the concept of evolution of the biosphere as a system subordinated to the cosmos. The ecosystem energy characteristics, which are of great criterial significance, presently are extremely unsatisfactorily determined due to procedural errors in the hydrobiological determination of production and decomposition. The view of the biosphere as a subsystem of the cosmos allows forecasting the possible consequences of changes in water ecosystems to be made more accurately and supports human efforts to protect the environment. (Baker-IVI)
W84-04130

PHYTOPLANKTON OF THE KURTLINSKOYE RESERVOIR,
Akademiya Nauk Turkmenskoi SSR, Ashkhabad. Inst. Botaniki.
Sh. I. Kogan, and Yu. Ue. Lyubeznov.
Hydrobiological Journal, Vol. 19, No. 1, p 11-17, 1983. 2 Fig, 5 Tab, 22 Ref.

Descriptors: *Phytoplankton, *Reservoirs, Kurtlinskoye Reservoir, Eutrophication, Nutrients, Runoff, Agricultural runoff, Water quality.

Long-term studies in the Kurtlinskoye (Turkmenia) reservoir showed that the structure and quantitative development of the phytoplankton there underwent significant changes due to extermination of vascular aquatic plants by the grass carp, and increased pollution. A sharp increase in phytoplankton biomass, oxygen deficit, content of nutrients, oxidizability, and biological oxygen demand suggests that the reservoir is becoming eutrophic. The major cause of pollution in this region is due to increased nutrients entering the water as a result of agricultural runoff. In recent years the fraction of beta-mesosaprobes has increased and that of the oligosaprobes has decreased somewhat. Three periods of development have been isolated from intensive study concerning the phytoplankton in the reservoir. The first period (1966-1970) involved weak quantitative development of the phytoplankton, with maximum taxonomic diversity. The second period (1970-1975) involved a major restructuring of the biocoenosis as a result of the destruction of the vascular plants, and development of the phytoplankton to initial bloom stage. The dominant complex was unstable, and the saprobicity increased. The third period (1975-1978) involved a further increase in the plankton biomass. The plankton community showed only slight yearly changes in composition and productivity. Proper management of the Kurtlinskoye Reservoir is needed if further deterioration of water quality is to be avoided. (Baker-IVI)
W84-04131

MACROBENTHOS COMMUNITIES OF THE NORTH CRIMEAN CANAL,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
T. A. Kharchenko.
Hydrobiological Journal, Vol. 19, No. 1, p 37-44, 1983. 7 Fig, 1 Tab, 15 Ref.

Descriptors: *Canals, *Macrobenthos, Macrozoobenthos, North Crimean Canal, Invertebrates, Decomposition, Organic matter.

The main coenoses of macrozoobenthos in the North-Crimean Canal (NCC) were identified. The energy flow through these coenoses was calculated. A more productive coenosis exists in the end zone of the canal. Two macrobenthos invertebrate communities were identified in the NCC. Based on an analysis of the species makeup, numbers, biomass, species frequency and metabolic processes of the individual groups of hydrobionts, with allowance for environmental factors, the first bottom coenosis identified in the canal has been named L. hoffmeisteri + P. breviantennatum community of sand clay bottom soils, and the second has been named the Dreissena + p. ferrugineus + D. hae-

mobaphes community of silted clay bottom soils. Decomposition of organic matter is proceeding actively in the canal, prompted to a certain extent by the functioning of the Dreissena consortium. Discovering the mechanism of this effect is a task for future study. (Baker-IVI)
W84-04132

ECOLOGIC PHYSIOLOGY AND BIOCHEMISTRY OF AQUATIC PLANTS AND MICROORGANISMS: CONTRIBUTION TO THE BIOLOGY AND COENOLOGY OF POTAMOGETON PERFOLIATUS L.,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
Sh. Gusak, A. I. Merezhko, and V.P. Gorbik.
Hydrobiological Journal, Vol. 19, No. 1, p 54-58, 1983. 5 Fig, 3 Tab, 8 Ref.

Descriptors: *Reservoirs, *Aquatic plants, Microorganisms, Kiev Reserovir, Plant growth, Seasonal variation, Distribution.

The structure and biomass of Potamogeton perfoliatus thickets, as well as biometric data on this species were considered in the Strakholesiye shallows of the Kiev Reservoir. Plant biomass was sampled over an area of 100 sq m at a depth of 1.6 m. The Howard-Williams and Longman sampler made it possible to collect samples of plants not only from the surface, but also from the depths. Lateral distribution in the thickets is heterogeneous both in the number of sprouts and biomass. Average biomass was 258 g of bone dry matter, per sq m, most of it concentrated below the first 1.8 m of the plant height. Mean leaf area per sq m of the thickets was 1.72 sq m. In studying the structure of beds of P. perfoliatus, account must be taken not only of the size of the patches, but also of the distribution (density) of plants in them, bearing in mind the nature of the biotope. (Baker-IVI)
W84-04135

ECOLOGICAL CHARACTERISTICS OF PHOTOSYNTHESIS OF PHYTOPLANKTON AND ITS ROLE IN THE ECOSYSTEM OF THE DNIEPER RESERVOIRS,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
A. D. Priymachenko.
Hydrobiological Journal, Vol. 19, No. 1, p 59-67, 1983. 6 Fig, 3 Tab, 10 Ref.

Descriptors: *Reservoirs, *Phytoplankton, Photosynthesis, Dnieper Reservoir, Eutrophication, Primary productivity.

The vertical distribution of the photosynthetic production and of the biomass of the phytoplankton in the Dnieper Reservoirs is expressed by curves of different kinds that do not correlate with one another. Most of the water columns of the Dnieper Reservoirs are fairly well saturated with phytoplankton. Photosynthesis occurs only in the surface layer, depending on insolation. When the density of algae is higher than 40 g/cubic m, photosynthesis rates decrease due to self-shading and reduction in the specific area per unit biomass. The role of phytoplankton in formation of organic matter, its decomposition and as a source of energy resources increases with trophicity of the water. (Baker-IVI)
W84-04136

WATER HUMUS IN LAKES LADOGA AND BAIKAL,
Akademiya Nauk SSSR, Borok. Inst. Biologii Vnutrennykh Vod.
B. A. Skopintsev.
Hydrobiological Journal, Vol. 19, No. 1, p 88-93, 1983. 2 Tab, 19 Ref.

Descriptors: *Plankton, *Lakes, Lake Ladoga, Lake Baikal, Oligotrophic lakes, Decomposing organic matter.

The nature of the water humus in the oligotrophic Lakes Ladoga and Baikal is considered. Allochthonous, terrigenic humus of soil and bog origin dominates in Lake Ladoga; autochthronous, planktonogenic humus in Lake Baikal. The analytical criteria were water color, rate of phytoplankton production, ratios between permanganate oxidizability and bichromate oxidizability and organic carbon. Validity of such an approach is confirmed by results of studies of different researchers on the nature of soil humus, sapropel, plankton and planktonogenic humus of waters and benthic deposits of the ocean and certain seas. Aromatic (cyclic) compounds are proved to dominate in terrigenic humus and aliphatic (acyclic) ones in the planktonogenic humus. (Baker-IVI)
W84-04137

WATER BALANCE OF A SMALL LAKE USING STABLE ISOTOPES AND TRITIUM,
Commonwealth Scientific and Industrial Research Organization, Glen Osmond (Australia). Div. of Soils.
J. V. Turner, G. B. Allison, and J. W. Holmes.
Journal of Hydrology, Vol. 70, No. 1-4, p 199-220, 1984. 14 Fig, 7 Tab, 21 Ref.

Descriptors: *Lakes, *Hydrologic budget, *Blue lake, *Australia, *Isotopic tracers, *Tritium, Recharge, Groundwater, Residence time, Carbon radioisotopes, Oxygen radioisotopes, Deuterium.

A small maar lake, known as the Blue Lake, set in a karstic region of southeastern Australia, provides the municipal water supply for a population of approximately 20,000. The lake has a volume of 36,000,000 cu m, of which 10-15% is pumped from it each year. The lake is recharged almost entirely from groundwater and the main objective of this study was to estimate the total groundwater inflow and outflow rates. Estimation of groundwater throughflow in a lake is different to assess using classical hydrological techniques and an alternative method involving measurement of the concentrations of the environmental isotopes H-3, O-18, H-2 and C-14 in the lake water and in the recharging groundwater was used to establish the lake-water balance. The water-balance calculations indicated a total groundwater inflow to Blue Lake of between 5,000,000 and 6,500,000 cu m/yr, corresponding to a residence time of water in the lake of approximately 6 yr. It was not possible to derive the relative proportions of inflow to the lake from the two possible source aquifers, using these isotopes, because their concentrations did not show a sufficiently large contrast to distinguish the two water sources. (Author's abstract)
W84-04151

HOLOCENE DEPLETION AND ACTIVE RECHARGE OF THE KALAHARI GROUNDWATERS - A REVIEW AND AN INDICATIVE MODEL,
Botswana Univ., Gaborone. Dept. of Geology.
J. J. De Vries.
Journal of Hydrology, Vol. 70, No. 1-4, p 221-232, 1984. 5 Fig, 1 Tab, 18 Ref.

Descriptors: *Kalahari desert, *Groundwater recharge, *Holocene, *Groundwater depletion, Topography, Infiltration, Aquifers, Hydraulic gradient.

Groundwater has been encountered in a large number of successful drillings in the Kalahari desert in different areas and formations. Locations of wells and boreholes are unevenly distributed and mostly related to topographic sites where groundwater can be found at shallow depth. A question in the evaluation of groundwater resources in the Kalahari is whether there is any active infiltration of present-day rainfall to the deep aquifers. The present study investigates whether the regional hydraulic gradient means a modern replenishment, or whether the slope of the piezometric surface should be explained as a residual feature resulting from head decay since the last pluvial period. The hydraulic gradient is most probably of a residual nature, and the replenishment has been less than 0.5 mm/yr during at least the last 4000 yr. The present groundwater depth and hydraulic gradient can be explained as a residual head caused by groundwater depletion due to an exceedance of discharge over recharge. The present-day discharge is most probably less than 0.5 mm/yr, and is either in dynamic equilibrium with current recharge, or still exceeds recharge, so that groundwater depletion will continue. Isotope studies gave evidence of local recharge to the Kalahari beds in areas favored by a combination of concentrated surface water and high permeability, creating local aquifers. (Moore-IVI)
W84-04152

SEASONAL CHANGE OF CHLOROPHYLL-A WITH BACTERIOCHLOROPHYLL IN LAKE FUKAMI-IKE,
Nagoya Women's Univ. (Japan). Faculty of Home Economics.
A. Yagi, I. Shimodaira, H. Terai, and Y. Saijo.
Japanese Journal of Limnology, Vol. 44, No. 4, p 283-292, October, 1983. 9 Fig, 13 Ref.

Descriptors: *Bacteria, *Phytoplankton, *Seasonal variation, *Chlorophyll, *Lake Fukami-ike, *Japan, Chlorophyll a, Chlorophyll c, Stratification.

Lake Fukami-ike is a small lake in central Japan having a maximum depth of 8.5 m, and is well protected from the wind. The lake has no inflowing streams, but it receives the runoff water from paddy fields, orchards and a certain amount of domestic sewage. The lake was stratified from March to October and circulated from November to March. Anoxic condition prevailed below 4-5 m depth from April to October. The amount of chlorophyll-a in the euphotic layer was low during the stagnation period, and high during the circulation period. Such a seasonal change in chlorophyll-a amount might be caused by: the interruption of upwards nutrient transportation form the tropholytic layer due to a distinct stagnation of water and the consumption of nutrients by photosynthetic sulfur bacteria growing near the top of anoxic layer in summer; and the sequential change of circulation and stagnation of water, producing favorable conditions for phytoplankton growth in winter. The highest values for bacteriochlorophyll c, about 140 to 120 micro g/l, were found near the top of the anoxic layer in the summer. (Moore-IVI)
W84-04165

DAILY OXYGEN BUDGETS IN A SUBMERGED PLANT STAND IN BROA RESERVOIR, SOUTHERN BRAZIL,
Chiba Univ. (Japan). Inst. of Marine Ecosystem.
I. Ikusima, K. Hino, and J. G. Tundisi.
Japanese Journal of Limnology, Vol. 44, No. 4, p 304-310, October, 1983. 4 Fig, 4 Tab, 10 Ref.

Descriptors: *Oxygen budget, *Aquatic plants, *Broa Reservoir, *Brazil, Standing crop, Photosynthesis, Algae, Diffusion, Respiration.

Daily oxygen budgets within a stand of submerged plants were measured in August, with the use of five cylindrical plastic tubes with different enclosure systems. The standing crop of living and dead plants at the experimental site was 47.9 and 37.5 g dry matter/sq m, respectively. Both daily total oxygen addition and that of oxygen loss in the water at the sand were estimated as 3.24 g O2/sq m/day. Daily gross productions of oxygen through photosynthesis by the submerged plants with their epiphytic algae and by epipelic algae accounted for 36% and 37% of the total oxygen addition, respectively. As much as 47% of the total loss was due to air released from water through diffusion, and 36% of that was due to total respiration. Both the daily amount of diffusion and its direction mainly depended upon the dissolved oxygen concentration at the researched water; daily amount of diffusion from water to air was estimated as 1.51 g O2/sq m/day, and the highest rate of oxygen diffusion was 0.21 g O2/sq m/hr for 12-15 hours, when the rate of net oxygen production of 0.32 g O2/sq m/hr was sustained. (Author's abstract)
W84-04168

2I. Water In Plants

EFFECTS OF WATER STRESS ON THE WATER RELATIONS OF PHASEOLUS VUL-

GARIS AND THE DROUGHT RESISTANT PHASEOLUS ACUTIFOLIUS,
Agricultural Research and Education Center, Lake Alfred, FL.
L. R. Parsons, and T. K. Howe.
Physiologia Plantarum, Vol. 60, No. 2, p 197-202, 1984. 4 Fig, 1 Tab, 29 Ref.

Descriptors: *Water stress, *Plant water potential, *Drought resistance, *Tepary bean, Leaves, Water potentials, Moisture deficiency.

Drought resistant plants can use sevaral mechanisms to postpone or tolerate dehydration. These include reduction of water loss by increased stomatal resistance, reduction of absorbed radiation by changes in leaf orientation, or reduction in leaf area. Mechanisms that tend to promote drought tolerance by maintaining turgor include osmotic adjustment, an increase in cell wall elasticity, or a decrease in cell size. The tepary bean (Phaseolus acutifolius Gray var. latifolius), a drought resistant species, was compared under water stress conditions with the more drought susceptible P. vulgaris L. cvs Pinto and White Half Runner (WHR). In order to better understand the basis for the superior drought resistance of tepary, this study was designed to determine the relationships among leaf water potential, osmotic potential, turgor potential, and relative water content (RWC). Plants were prestressed by withholding irrigation water. These stress pretreatments changed the relation between leaf water potential and relative water content of both species so that prestressed plants had lower water potentials than controls at the same leaf RWC. Tepary had lower water potentials at given RWC levels than Pinto or WHR; this can account for part of the superior resistance of tepary. In all genotypes, prestressed plants maintained osmotic potentials approximately 0.2 MPa lower than controls. Tepary reached osmotic potentials that were significantly lower (0.15 to 0.25 MPa) than Pinto or WHR. Both control and prestressed tepary plants had 0.05 to 0.25 MPa more turgor than Pinto or WHR at RWC values between 65 and 80%. Both prestressed and control tepary plants had greater elasticity (a lower elastic modulus) than Pinto or WHR. This greater turgor of tepary at low RWC values could be caused by several factors including greater tissue elasticity, active accumulation of solutes, or greater solute concentration. Tepary had significantly lower osmotic potentials than the P. vulgaris cultivars, but there was little difference in osmotic potential between Pinto and WHR. Knowledge of differences in osmotic and turgor potentiels among and within species could be useful in breeding for drought resistance in Phaseolus. (Murphy-IVI)
W84-03870

GROWTH, WATER POTENTIAL AND ION ACCUMULATION IN THE INLAND HALOPHYTE ATRIPLEX TRIANGULARIS UNDER SALINE FIELD CONDITIONS,
Ohio Univ., Athens. Dept. of Botany.
T. E. Riehl, and I. A. Ungar.
Acta Oecologica-Oecologia Plantarum, Vol. 4, No. 1, p 27-39, 1983. 5 Fig, 5 Tab, 24 Ref. NSF grant DEB7927236.

Descriptors: *Plant growth, *Saline soils, *Atriplex, Water potentials, Plant water potential, Salt marshes, Sodium, Chlorides, Rittman, Ohio.

Atriplex triangularis, an annual halophyte in the family Chenopodiaceae, has a wide distribution but generally occurs in inland and coastal salt marshes. The effect of soil conditions on the growth and distribution of A. triangularis were investigated on an inland salt marsh at Rittman, Ohio. The study site consists of three zonal communities, each dominated by populations of a single species. Atriplex plants which grow adjacent to the Salicornia zone (Atriplex wet zone) are subjected to generally more saline and wetter soils than those growing nearer to Hordeum-Atriplex zone (Atriplex dry zone) or those growing with Hordeum jubatum (Hordeum-Atriplex zone). Plant dry matter production in the most highly saline habitats was less than 50% of that in the less saline sites. In the most saline environment, all plants were dead by the end of July prior to reaching the flowering stage. Increases in soil salinity were significantly correlated with increasing sodium and chloride ion content and more negative water potentials in roots and shoots of A. triangularis. High plant densities also reduced dry weight production in A. triangularis. (Baker-IVI)
W84-03872

EFFECTS OF WATER AND NITROGEN SUPPLY ON THE COMPETITION BETWEEN THREE PERENNIAL MEADOW GRASSES,
California Univ., Irvine. Dept. of Ecology and Evolutionary Biology.
M. R. Sharifi.
Acta Oecologica-Oecologia Plantarum, Vol. 4, No. 1, p 71-82, 1983. 4 Fig, 3 Tab, 36 Ref.

Descriptors: *Meadows, *Plant growth, *Grasses, *Nitrogen, *Water supply, Stress, Bromus, Alopecurus, Arrhenatherum, Groundwater.

The biomass production with and without competition of Alopecurus pratensis, Arrhenatherum elatius, and Bromus erectus was examined in lysimeter experiments using three different levels of nitrogen fertilization and water supply. Alopecurus was the strongest competitor under almost all conditions, while Bromus was the weakest competitor. The success of Arrhenatherum in mixed culture varied with ground water level and nitrogen fertilization. The physiological behavior of Alopercurus was similar to its ecological behavior. Arrhenatherum was forced into drier, nitrogen-poorer conditions by Alopecurus. Bromus was encroached upon by both other species under all conditions. The concept of competition and its effects on the ecological behavior of these three species is discussed. The major conclusion was that while stress tolerators such as Bromus erectus, grow in areas where there is competition, they grow much better in stress free situations. (Baker-IVI)
W84-03873

WATER STRESS AND TREE PHENOLOGY IN A TROPICAL DRY FOREST IN THE LOWLANDS OF COSTA RICA,
P. B. Reich, and R. Borchert.
Journal of Ecology, Vol. 72, No. 4, p 61-74, March, 1984. 3 Fig, 34 Ref.

Descriptors: *Water stress, *Trees, *Phenology, *Costa Rica, Tropical region, Seasonal variation, Plant growth, Plant water potential, Available water.

It has long been recognized that seasonal changes in the physiognomy of tropical forests are caused primarily by seasonal variation in rainfall, which in conjunction with soil moisture availability is the principal determinant of tree water status. Phenology and seasonal variations in water stress, as indicated by variations in girth, were monitored for 1 yr in numerous trees of twelve species, growing at dry and moist sites in a tropical lowland deciduous forest in Guanacaste, Costa Rica. At dry sites, trees experienced water stress and shed their leaves early in the dry season. In most species, rehydration, followed by bud break, took place only after heavy rainfalls. In some species, leaf shedding was followed by rehydration and bud break during continuing drought. During shoot extension, which rarely lasted longer than a few weeks, trees experienced water stress in spite of growing in wet soils. At wet sites, trees experienced little or no apparent water stress; they remained evergreen or rapidly exchanged leaves during the dry season. In general, the timing of leaf fall and bud break and, in many species, anthesis was determined to a large extent by changes in tree water status. These phenomena, in turn, were a function of the interaction between the water status of the environment and the structural and functional state of the tree. At times the functional state of the tree would counteract the environmental influences; trees with growing shoots experienced temporary water deficits during the wet season, and bare trees rehydrated during drought. The seasonal pattern of tree development had a high correlation with seasonal variation in tree water status, but only indirectly with environment water availability. No evidence was found for the control of tree development by seasonal variation in photoperiod or temperature. (Murphy-IVI)
W84-03950

WATER RELATIONS OF DACTYLIS GLOMERATA AND DICHANTHIUM ISCHAEMUM CULTIVATED UNDER TWO DIFFERENT WATER REGIMES (RELATIONS HYDRIQUES CHEZ DACTYLIS GLOMERATA ET DICHANTHIUM ISCHAEMUM CULTIVES SOUS DEUS REGIMES HYDRIQUES CONTRASTES),
Thessalonika Univ., Salonika (Greece). Lab. de Science des Paturages.
B. Noitsakis, and A. Berger.
Acta Ecologia, Vol. 5, No. 1, p 75-88, 1984. 8 Fig, 3 Tab, 33 Ref.

Descriptors: *Plants, *Water stress, *Dactylis, *Dichanthium, Stomata, Temperature effects, Hydrologic budget.

The relative occurrence of the two plant types, C3 species and C4 species, has most often been related to their different responses to temperature. Responses to water stress have recently been investigated in Dactylis glomerata (C3) and Dichanthium ischaemum (C4). Water balance by the C3 species is characterized mainly by a regulation of stomatal conductance, which shows a plastic response to water stress. The C4 species is characterized by high root and stem conductance and by a low plasticity of stomatal regulation. Hydrodynamic characteristics of the leaves are plastic in both species. The C3 species response is likely controlled more by photoperiod than by water stress while that of the C4 species is independent of photoperiod but is controlled by water stress. (Baker-IVI)
W84-04058

SOIL AND XYLEM WATER POTENTIAL AND SOIL WATER CONTENT IN CONTRASTING PINUS CONTORTA ECOSYSTEMS, SOUTHEASTERN WYOMING, USA,
Wyoming Univ., Laramie. Dept. of Botany.
T. J. Fahey, and D. R. Young.
Oecologia, Vol. 61, No. 3, p 346-351, March, 1984. 5 Fig, 1 Tab, 24 Ref.

Descriptors: *Soil water, *Soil water potential, *Soil-water-plant relationships, *Xylem water potential, *Pine, *Wyoming, Water stress, Rhisosphere moisture, Soil porosity, Soil structure.

The relationships between volumetric soil water content (theta), in situ soil water potential (psi soil) and predawn xylem pressure potential (psi predawn) were quantified in four contrasting lodgepole pine ecosystems in Wyoming, USA. On three of the sites, changes in psi soil correlated closely with psi predawn, but on a porous soil derived from coarse granitic parent material, psi predawn declines occurred much sooner than corresponding declines on psi soil, possibly because of local depletion of rhizosphere moisture and low molecular diffusivity of water in that soil. Extrapolation of laboratory-derived characteristic curves for soil moisture to field conditions yielded different relationships between theta and psi soil than curves derived from in situ measurements, probably because of disruption of soil structure and porosity during samples collection and handling in laboratory studies. Although a close correlation between theta and psi predawn was observed, future efforts at modelling the soil-plant-atmosphere continuum should be directed towards a more detailed understanding of the complex relationships between psi soil at varying depths and plant water stress. (Author's abstract)
W84-04175

WATER LOSS AND MALATE FLUCTUATIONS DURING THE DAY FOR PLANTS IN THE SOUTHERN NAMIB DESERT,
Bayreuth Univ. (Germany, F.R.).
D. J. v. Willert, E. Brinckmann, B. M. Eller, and B. Scheitler.
Oecologia, Vol. 61, No. 3, p 393-397, March, 1984. 3 Fig, 1 Tab, 15 Ref.

Descriptors: *Desert plants, *Water loss, *Transpiration, *Namib desert, Photosynthesis, Leaf conductance, Malate, Succulence.

The daily course of transpiration for 12 different plants growing in the southern Namib desert was investigated. Sclerophyllous species with C3 photosynthesis were the most effective water savers followed by succulents exhibiting CAM, while C3 pathway-succulents lose as much water as malacophyllous species. The different species showed either one or two peaked patterns of both transpiration and leaf conductance. With C3 plants the most common pattern is a single morning peak in leaf conductance followed by decreases in conductance over the remainder of the day. With CAM succulents leaf conductance is high in the morning, shows a pronounced midday depression and increases in the early afternoon when the malate pool is depleted, but malate consumption did not start earlier than 4 h after dawn. Seven of nine investigated C3 plants had rather high contents of malate, up to 180 micromol/g dry matter. In these plants the malate content increased with increasing leaf conductance and disappeared when leaf conductance declined in the evening, indicating that malate was synthesized during photosynthesis. (Author's abstract)
W84-04176

2J. Erosion and Sedimentation

DEBRIS FLOW HAZARD ASSESSMENT FOR THE OREGON CAVES NATIONAL MONUMENT,
Geological Survey, Portland, OR. Water Resources Div.
For primary bibliographic entry see Field 2G.
W84-03577

PRELIMINARY SEDIMENT NETWORK EVALUATION FOR THE PICEANCE BASIN, NORTHWESTERN COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7A.
W84-03585

MEASUREMENT OF BEDLOAD DISCHARGE IN NINE ILLINOIS STREAMS WITH THE HELLEY-SMITH SAMPLER,
Geological Survey, Urbana, IL. Water Resources Div.
J. B. Graf.
USGS Water-Resources Investigations Report 83-4136, 1983. 70 p, 10 Fig, 28 Tab, 11 Ref.

Descriptors: *Bedload discharge, *Sediment transport, *Fluvial sediments, Rivers, Sampling, *Helley-Smith bedload sampler, *Bedload discharge rating curves, *Illinois.

Samples collected with the Helley-Smith bedload sampler provide useful information about transport of sand-size sediment in Illinois streams. Samples provide the basis for bedload-discharge rating curves for the Rock and Kaskaskie Rivers and Henderson Creek. Comparison of measured bedload discharge with bedload discharge computed for selected flow conditions from channel characteristics allows the selection of an appropriate indirect method for determining bedload discharge for the Spoon, Kishwaukee, and Edwards Rivers. No one indirect method best represents bedload discharge in studied streams. No bedload-discharge rating curve was developed for the La Moine River, because the two measured bedload discharges are not sufficient for development of a rating curve and do not agree well with discharges computed by any of the three indirect methods. The dominant size of bedload particles in all streams sampled give results which cannot be used at this time. Collection-bag clogging may have been significant in the Green River, and large bed material gains or high flow velocities may have interfered with the operation of the sample in the Vermilion River. (USGS)
W84-03590

PRINCIPLE AND APPLICATION OF SEDIMENT EFFECTIVE POWER,
Tianjin Univ. (China). Dept. of Hydraulic Engineering.
S-Y. Wang.
Journal of Hydraulic Engineering (ASCE), Vol. 110, No. 2, p 97-107, February, 1984. 5 Fig, 4 Tab, 13 Ref. NSF grant ENG 7825054.

Descriptors: *Sediment effective power, Mathematical models, Sediment-water interfaces, Sediment transport, Open channel, Bed load, Sediment concentration, Sediment-carrying capacity, Flow.

From an energy analytical standpoint, the energy which can support the sediment load of streamflow in suspension is considered only a part of the total energy loss in the streamflow. The concept of potential velocity is introduced to explain the principle of sediment effective power. From the principle of effective power of sediment consideration, an equation has been developed for calculating the variation of the von Karman constant in sediment-laden flow. On this basis, a new classification of moving sediment in an open channel is suggested and a description of the applications to river sedimentation is presented. The variation of von Karman constant in sediment-laden flow, the distinction between wash load and bed-material load, as well as the adequacy of sediment transportation formulas are reviewed. (Murphy-IVI)
W84-03716

FORMATION AND EFFECTS OF ALTERNATE BARS,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
For primary bibliographic entry see Field 8B.
W84-03719

MODELING OF RIVER CHANNEL CHANGES,
For primary bibliographic entry see Field 8B.
W84-03720

INDUS PARADOX,
National Inst. of Oceanography, Panaji (India).
For primary bibliographic entry see Field 8D.
W84-03729

EROSION AND SEDIMENT TRANSPORT IN THE GANGES RIVER BASIN (INDIA),
Jawaharlal Nehru Univ., New Delhi (India). School of Environmental Sciences.
N. Abbas, and V. Subramanian.
Journal of Hydrology, Vol. 69, No. 1, p 173-182, February, 1984. 5 Fig, 3 Tab, 17 Ref.

Descriptors: *Erosion, *Sediments, *India, *Ganges River, Sedimentation, Sediment transport, Sediment load, Denudation, River basins.

Based on the observed erosion rates, the Ganges river system would reach mean sea level in about 4,000,000 yr. However, some of the sub-basins have much higher rates, such as 8,000,000 yr for the Yamuna basin. The basement of the Ganges basin lies below the 6 km thick alluvium. Such a great thickness requies a continuous supply of sediments for at least the past 5,000,000 yr. Thus, the calculated time for basin activity should be corrected for compensating mechanisms such as uplift before the life of a basin can be determined. Annual decrease in basin elevation indicates a rapid process of denudation and such rates have a bearing on rates of shelf sediment accumulation. (Baker-IVI)
W84-03782

SUSPENDED MATTER, MAJOR CATIONS AND DISSOLVED SILICON IN THE ESTUARINE WATERS ON THE MAHANADI RIVER, INDIA,
Utkal Univ., Bhubaneswar (India). Dept. of Geology.
S. B. Ray, M. Mohanti, and B. L. K. Somayajulu.
Journal of Hydrology, Vol. 69, p 183-196, 1984. 5 Fig, 2 Tab, 25 Ref.

Descriptors: *Suspended matter, *Cations, *Dissolved silicon, *Estuaries, *Mahanadi River, *India, Sodium, Potassium, Magnesium, Calcium, Silicon, Trace metals, Sediment transport, Bay of Bengal, Monsoons, Sediment concentration.

A knowledge of suspended and soluble inputs from rivers to the ocean as well as their major- and trace-elemental composition is essential for calculating material balances for various elements and to find out their possible sinks and sources. Results of extensive measurements of suspended matter, major cations Na, K, Mg, Ca and dissolved Si in the waters of the Mahanadi estuary during seven sampling periods between 1977 and 1981 are reported. The particulate concentrations ranged from 0.6 to 596 mg/l during all sampling periods with the highest concentrations occurring in the monsoon season. The mean annual suspended load from the Mahanadi is estimated to be 1.4 x 10 to the 17th power g, almost all of which is monsoonal contribution. Na, K and to a large extent Mg and Ca behave conservatively in the estuary and their annual dissolved fluxes to the Bay of Bengal are: 2.6 x 10 to the 15th power, 7 x 10 to the 14th power, 1.3 x 10 to the 15th power and 4.2 x 10 to the 15th power g, respectively. Si behaves nonconservatively, there is a net removal of 11% of the total annual dissolved Si supply of 3.3 x 10 to the 15th power g to the Bay of Bengal. A major part of this removal occurs during the winter months and appears to be biological. (Murphy-IVI)
W84-03783

GUIDE TO THE LARVAE OF THE NEARCTIC DIAMESINAE (DIPTERA;CHIRONOMIDAE): THE GENERA BOREOHEPTAGYIA, PROTANYPUS, DIAMESA, AND PSEUDOKIEFFERIELLA,
Geological Survey, Doraville, GA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-03848

CHARACTERISTICS OF SUSPENDED SEDIMENT IN THE SAN JUAN RIVER NEAR BLUFF, UTAH,
Geological Survey, Salt Lake City, UT. Water Resources Div.
K. R. Thompson.
Available from the Ofss, USGS, Lakewood, CO 80225, Price: $3.25 in paper copy, $3.50 in microfiche. USGS Water-Resources Investigations Report 82-4104, 1982. 21 p, 8 Fig, 3 Tab, 5 Ref.

Descriptors: *Fluvial sediment, *Sediment concentration, Discharge, Sediment load, Sediment sampler, *Colorado River basin, San Juan River basin.

Fluvial-sediment data were collected for the San Juan River near Bluff beginning in 1914 and terminating in 1980. A double-mass curve showed a change in relationship between annual suspended-sediment discharge and annual stream discharge between the water years 1941-44 and 73. Possible causes for these changes in laboratory procedures, and unusually large runoff that occurred in 1941 and 1972. An unknown or unidentified factor may also be involved. The actual reason for this change in relationship may never be fully understood. Navajo Dam apparently has had no significant effect on fluvial sediment at the sampling site. Mean annual suspended sediment discharge in the San Juan River near Bluff was about 25,410,000 tons ranging from 3,234,000 tons in 1978 to 112,400,000 tons in 1941. The use of annual stream discharge to predict annual suspended-sediment discharge at the site will produce poor results because of size and diversity of the basin and the quality of records available. A positive correlation exists between sand concentration and stream discharge at this site, however, considerable variability is evident. This relationship does not exist when stream discharge exceeds 6,000 cubic feet per second. It is recommended that if collection of suspended-sediment records be resumed in this reach of the river an alternative sampling site should be selected and the use of pumping sam-

plers considered because of the remoteness of the area. (USGS)
W84-03851

MUDFLOW HAZARDS ALONG THE TOUTLE AND COWLITZ RIVERS FROM A HYPOTHETICAL FAILURE OF SPIRIT LAKE BLOCKAGE,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 2E.
W84-03856

FORMATION OF PERYLENE IN RECENT SEDIMENTS: KINETIC MODELS,
Indiana Univ. at Bloomington. School of Public and Environmental Affairs.
P. M. Gschwend, P. H. Chen, and R. A. Hites.
Geochimica et Cosmochimica Acta, Vol. 47, No. 12, p 2115-2119, December, 1983. 1 Fig, 1 Tab, 21 Ref. NSF grant OCE-80-05997, DOE grant 80-EV-10449.

Descriptors: *Hydrocarbons, *Sedimentology, *Ponds, *Sediments, *Perylene, Mountain Pond, Maine, Chemical reactions, Kinetics.

Perylene is a pentacyclic aromatic hydrocarbon which has been found in many recent sediments. The concentration of perylene increased regularly with depth in a radiometrically dated sediment core from Mountain Pond, Coburn Mountain, Maine. This high altitude pond is small, shallow and oligotrophic. The location of the pond precludes large interfering inputs of anthropogenic perylene or perylene from weathered rocks. This concentration profile was fit to simple reaction kinetic models which indicate that perylene forms in this core either by a first order reaction characterized by a rate constant of 0.012/yr or by a second order reaction characterized by a rate constant of 0.0013 nmole/g/yr. Such perylene data may be used to judge the constancy, not only of amount but also of kind, of organic matter accumulated. The depth of initial perylene formation may indicate an important reductive horizon in the core while a regularly increasing perylene profile may demonstrate that the anoxic conditions have not varied. Analysis of perylene is not difficult and does not appear to be influenced by sampling or storage artifacts. Thus, perylene could be a very useful geochemical indicator. (Baker-IVI)
W84-03863

MIXING RATES IN SHAGAWA LAKE, MINNESOTA, SEDIMENTS AS DETERMINED FROM 106-RU PROFILES,
Oregon State Univ., Corvallis. School of Oceanography.
J. Van Sickle, W. C. Weimer, and D. P. Larsen.
Geochimica et Cosmochimica Acta, Vol. 47, No. 12, p 2189-2197, December, 1983. 3 Fig, 3 Tab, 36 Ref.

Descriptors: *Lake sediments, *Minnesota, *Shagawa Lake, *Mixing, Radioisotopes, Ruthenium, Sediments, Cesium, Lead, Enrichment, Bioturbation.

Rates of surficial sediment mixing and sediment burial are measured in Shagawa Lake, Minnesota, using radionuclide tracers. Based on Ru-106 profiles in 16 cores, mixing rates average 13 sq cm/yr within the upper 9 cm of sediment. Two other nuclides, Pb-210 and Cs-137, provide further evidence for calculation of mixing rates. In addition, Pb-210 profiles estimate sediment burial rates (about 0.4 cm/yr). Mixing estimates are shown to be fairly insensitive both to uncertainties in sediment burial rates and to temporal patterns of Ru-106 deposition. Results suggest that the deeper sediments in the lake were laid down and buried for some distance during a period of little mixing. Near-surface sediment reworking is likely due to bioturbation. Thus it is reasonable to hypothesize that the benthic fauna, along with its mixing effects, was meager prior to 1900, but has increased greatly since in response to Shagawa Lake's rapid enrichment. (Baker-IVI)
W84-03864

PROCESS OF SEDIMENTATION ON THE SURFACE OF A SALT MARSH,
Delaware Univ., Newark. Coll. of Marine Studies.
R. P. Stumpf.
Estuarine, Coastal and Shelf Science, Vol. 17, No. 5, p 495-508, November, 1983. 4 Fig, 3 Tab, 31 Ref.

Descriptors: *Sedimentation, *Salt marshes, Sediment transport, Sediment size, Holland Glade Marsh, Lewes, Delaware.

An unditched salt marsh-creek drainage basin (Holland Glade Marsh, Lewes, Delaware) has a sedimentation rate of 0.5 cm/year. During normal, storm free conditions, the creek carries negligible amounts of sand and coarse silt. Of the material in the waters flooding the marsh surface, over 80% disappears from the floodwaters within 12 m of the creek. About one-half of the lost material is theoretically too fine to settle, even if flow were not turbulent; however, sediment found on Spartina stems can account for the loss. The quantity of suspended sediment that does reach the back marsh during these normal tides is inadequate to maintain the marsh surface against local sea level rise. This suspended sediment is also much finer than the deposited sediments. Additionally, remote sections of low marsh, sections flooded by only the highest spring tides, have 15-30 cm of highly inorganic marsh muds. This evidence indicates that normal tide flooding does not produce sedimentation in Holland Glade. Study of the effects of two severe storms, of a frequency of once per year, suggests that such storms can deposit sufficient sediment to maintain the marsh. The actual deposition of the fine-grained sediments (fine silt and clay) appears to result primarily from biological trapping rather than from settling. In addition, this study proposes that the total sedimentation on mature marshes results from a balance between tidal and storm sedimentation. Storms will control sediment supply and movement on micro- and meso-tidal marshes, and will have less influence on macro-tidal marshes. (Author's abstract)
W84-03897

IMPROVED NUMERICAL MODEL FOR SEDIMENTATION,
Hochschule der Bundeswehr, Munich (Germany, F.R.). Faculty of Civil Engineering.
W. Bechteler, and W. Schrimpf.
Journal of Hydraulic Engineering, Vol. 110, No. 3, p 234-246, March, 1984. 7 Fig, 1 Tab, 10 Ref.

Descriptors: *Mathematical model, *Sedimentation, Mathematical equations, Settling tanks, Dimensional analysis, Wastewater treatment, Diffusion coefficient.

The sedimentation process is an important aspect of the planning and running of many hydraulic and sewage plants. An improved method is developed for the practical dimensioning of horizontal settling tanks. Using this method completed diagrams can be provided to determine the necessary settling lengths for every given removal ratio. The concerned differential equation is solved by a numerical method which can avoid numerical diffusion, therefore predicting more accurately removal ratios in settling basins. Also, concentration profiles and diagrams for dimensioning retarding basins can be computed for different initial and boundary conditions. The flexibility of the model is of practical value with regard to various inlet concentrations and velocity profiles that can be considered. (Murphy-IVI)
W84-03918

SEDIMENT TRANSPORT FORMULA FOR STEEP CHANNELS,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
G. M. Smart.
Journal of Hydraulic Engineering, Vol. 110, No. 3, p 267-276, March, 1984. 4 Fig, 3 Tab, 9 Ref.

Descriptors: *Mathematical equations, *Sediment transport formula, *Steep channels, Sedimentation, Sedimentation rates, Meyer-Peter Mueller equation, Comparison studies, Slopes.

A description is given and results presented of experiments to investigate the sediment capacity of stream flows on flume slopes of up to 20%. A comparison of the results with values predicted by the Meyer-Peter Mueller equation shows that the latter equation seriously underestimates sediment transport capacity on slopes steeper than 3%, mainly because of deficiencies in the form resistance factor. A new equation is proposed, giving the transport capacity for materials with grain sizes larger than 0.4 mm (0.016 in.). The equation is calibrated by both the original Meyer-Peter data and new steep flume experiments and modified to incorporate the effect of nonuniform sediment grain size distributions. With flow depths calculated by the Manning-Strickler equation the new equation still gives excellent estimates of sediment capacity. (Author's abstract)
W84-03919

BED LOAD TRANSPORT OF COARSE NON-UNIFORM SEDIMENT,
Regional Engineering Coll., Srinagar (India).
R. L. Misri, R. J. Garde, and K. G. Ranga Raju.
Journal of Hydraulic Engineering, Vol. 110, No. 3, p 312-328, March, 1984. 13 Fig, 1 Tab, 22 Ref.

Descriptors: *Bed load, *Sediment transport, *Coarse sediments, Nonuniform Sediments, Sedimentation, Mathematical models, Mathematical equations, Comparison studies.

A model of bed load movement may be conceived on the assumption that lift is the predominant force influencing the motion of particles smaller than the arithmetic mean size, d sub a, since these particles are hidden in the wakes of the larger particles. Both drag and lift are assumed to affect the motion of the coarser particles. Four coarse uniform materials and 9 sediment mixtures were used as the bed material. There was good agreement only with Einstein's relation when a comparison was made between other bed load relations. A conceptual model for the effect of a particular size of sediment on the transport rates of other sizes of sediment is proposed. The experimental data are analyzed with the dual objectives of assessing the accuracy of existing methods of computation of bed load transport and of proposing a new method of computation. (Murphy-IVI)
W84-03923

SOURCES AND DISTRIBUTIONS OF SEDIMENTARY ORGANIC MATTER IN THE COLUMBIA RIVER DRAINAGE BASIN, WASHINGTON AND OREGON,
Washington Univ., Seattle. School of Oceanography.
J. I. Hedges, H. J. Turin, and J. R. Ertel.
Limnology and Oceanography, Vol. 29, No. 1, p 35-46, January, 1984. 4 Fig, 3 Tab, 33 Ref. NSF grants OCE 80-23970 and DEB 79-12241.

Descriptors: *Sediments, *Organic matter, *Drainage basins, *Columbia River, *Washington, *Oregon, Basins, Sediment transport, Angiosperms, Gymnosperms, River basins, Lignins, Vegetation.

The Columbia is one of the major river systems of the world with a total drainage basin of 670,000 sq km and a mean annual discharge of 7,200 cu m/s. Nonwoody angiosperm tissues and gymnosperm woods are the major types of vascular plant debris in bottom sediments from 16 sites within the Columbia River and its tributaries. There is a clear relationship between geographic trends in local vegetation and the sedimentary lignin composition of the Columbia River tributaries. In the extensively dammed main river, the vascular plant debris mixtures are more uniform, thus indicating downstream mixing of sedimentary material from reservoir to reservoir. Vascular plant tissues account for an average of a third of the total sedimentary organic matter at the 16 river sites. The remaining organic material has an atomic C:N of 10-15 and a stable carbon isotope composition similar to average land plants. Organic matter in sediments of the Columbia River system is generally enriched in nonwoody angiosperm tissues and lignin-poor or-

ganic matter in comparison to Columbia River derived organic matter in modern marine sediments from the southern Washington continental shelf. (Baker-IVI)
W84-03960

TRANSPORT AND BREAKDOWN OF FECAL PELLETS: BIOLOGICAL AND SEDIMENTOLOGICAL CONSEQUENCES,
Washington Univ., Seattle. School of Oceanography.
G. L. Taghon, A. R. M. Nowell, and P. A. Jumars.
Limnology and Oceanography, Vol. 29, No. 1, p 64-72, January, 1984. 2 Fig, 4 Tab, 36 Ref.

Descriptors: *Benthic environment, *Sediment transport, *Fecal pellets, Benthos, Aquatic life, Benthic fauna, Aquatic animals, Worms, Feces.

Direct and independent measurements were taken of the densities, sizes, and settling velocities of fecal pellets produced by Amphicteis scaphobranchiata, a deposit-feeding polychaete worm. Pellet density was measured by an isosmotic density gradient technique. Densities ranged from 1.086 to 1.282 g/cu cm and settling velocities from 3.03 to 5.94 cm/sec. Pellets were transported as bedload for variable distances. The oldest pellets tested were 6 hr after production. These traveled a median distance of 3.1 m. Freshly egested pellets traveled 9.5 m before disintegrating. While worms would reingest disaggregated pellets, feeding rates correlated positively with pellet age, consistent with earlier findings that this species feeds at a faster rate on energetically more profitable sediment. Substantial interactions among benthic animals, fecal pellets, and the processes of sediment transport are thus verified. (Baker-IVI)
W84-03961

SEDIMENTATION PROBLEMS IN RIVER BASINS,
Uppsala Univ. (Sweden). Naturgeografiska Inst.
A. Sundborg.
Nature and Resources, Vol. 19, No. 2, p 10-21, April-June, 1983. 12 Fig, 1 Tab, 7 Ref.

Descriptors: *Erosion control, *Sedimentation, *River basins, Erosion, Rainfall-runoff relationships, Land use, Agriculture, Sediment transport, Forest management.

In 1975 under the International Hydrological Programme, a project was established to investigate the relationship between sedimentation and erosion on the one hand, and fishing, forestry, wildlife, agriculture, grazing, mining and construction work on the other. The international dimensions of the environmental problems involved are discussed. Man's use of the land can result in accelerated erosion and deposition, river migration, channel-regime changes and many other effects. Problems can occur in three different environments: the source area delivering the material, the river channel system forwarding the load, and the depositional environment, where the particles come to rest. The purpose of taking corrective measures for the control of erosion and sedimentation processes is to reduce or eliminate negative effects. The evaluation of economic losses due to soil erosion and sedimentation problems is a complicated procedure. Actual costs are easy to calculate for specific soil conservation measures and for hydraulic structures in rivers. However, it is more difficult to evaluate costs in economic terms of losses caused by soil deterioration in the upper river basin. International cooperation in soil conservation efforts is needed. (Baker-IVI)
W84-03970

UNSTEADY SEDIMENTATION IN NONUNIFORM RILLS,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
T. E. Croley, II, and G. R. Foster.
Journal of Hydrology, Vol. 70, No. 1-4, p 101-122, 1984. 14 Fig, 1 Tab, 4 Ref.

Descriptors: *Sedimentation, *Runoff, *Rill flow, *Interrill flow, Kinematics, Mathematical models, Overland flow, Hydraulic models, Soil erosion.

The objective of the field study was to measure, very frequently, runoff rate and sediment concentration precisely, until both reached equilibrium. The model being validated assumes a system of parallel ridges and furrows where rill and interrill areas can be precisely defined. The experiments were conducted on a silt-loam soil on a 5% slope. Constant intensity rainfall was applied with a rainfall simulator having impact velocities near those of natural rainfall. The kinematic unsteady overland sedimentation theory of prismatic channels is extended to the experiments by considering both hydraulics and sediment dynamics of rill flow for changing flow geometries of nonuniform and unsteady rill development. The characteristic unimodal concentration peak observed in the experiments and the changing geometry were interpreted in theoretical terms. Overland sedimentation in unsteady nonprismatic rills under uniform rainfall can be described with kinematic models of flow, entrainment and deposition applied to developing flow geometries; this is not possible with sheet-flow models. The hydraulic and sedimentation results are consistent in that each points to the existence of nonprismatic channel developments. The rills develop from deep and narrow, upstream to wide and shallow in the downstream direction, resulting in velocity reduction with increasing flow that is reflected in both the hydraulic analysis and the sedimentation analysis. (Moore-IVI)
W84-04145

2K. Chemical Processes

THERMAL SPRINGS IN THE BOISE RIVER BASIN, SOUTH-CENTRAL IDAHO,
Geological Survey, Boise, ID. Water Resources Div.
For primary bibliographic entry see Field 2F.
W84-03588

ACID PRECIPITATION: THINGS ONE CAN DO - THE TUG HILL COMMISSION APPROACH,
New York State Temporary Commission on Tug Hill, Watertown.
D. J. Beevers.
Report, October, 1982. 24 p, 3 Fig, 9 Ref, 1 Append.

Descriptors: *Acid rain, *Public policy, *Public participation, *Environmental policy, Long-term planning, Legislation, Public opinion, Regional planning, Water quality, Economic impact.

Acid precipitation is an international problem requiring more knowledge of its causes and effects, increased public awareness, and national policies to address it. New York's Temporary Tug Hill State Commission, with limited budget, small staff, and only regional jurisdiction, has sought to learn and provide information about acid precipitation and to impact public policy. Only a limited amount of basic research has been conducted in the Tug Hill area, which encompasses 1.3 million acres in 39 towns in portions of four counties. Acid precipitation data collected from four U.S.G.S. monitoring stations (Canton, Stillwater, Hinkley, May's Point) surrounding the area and the National Atmospheric Deposition Program station at Bennett Bridge within the Tug Hill study area, as well as other data, indicate that the area receives a large quantity of highly acidic precipitation. For example, the average lab pH for 22 samples taken at Bennett Bridge between June and December 1980 (the only data available) was 4.09. Some red spruce and red maple die-back may be linked to acid precipitation. The Commission has implemented a variety of activities in response, including use of students to survey acid precipitation, policy statements, research projects on water quality and forest impacts, and design and implementation of a public opinion survey that may lead to additional public awareness, legislative action, and research. Most of these are relatively low-cost activities that similar agencies or other groups could participate in or initiate. (Fazio-Omniplan)
W84-03656

ACID PRECIPITATION AND THE SALMON RIVER SYSTEM, TUG HILL, NEW YORK,
Clarkson Coll. of Technology, Potsdam, NY. Dept. of Civil and Environmental Engineering.
J. V. DePinto, and P. Dentice.
Report, Temporary State Commission on Tug Hill, February, 1977. 49 p, 6 Fig, 6 Tab, 27 Ref, 1 Append.

Descriptors: *Acid rain, *Acid streams, *Chemistry of precipitation, *Acidity, Water sampling, Macroinvertebrates, Areal precipitation, Chemical analysis, Hydrogen ion concentration, Sulfates, Nitrates, Alkalinity, Calcium.

Possibly one of the most serious consequences of this country's tremendous utilization of energy resources could be the acidification of land and water in the northeastern United States as a result of the emission, transport, oxidation and hydrolysis, and deposition of sulfur oxides and nitrogen oxides produced in the consumption of fossil fuels. In accordance with the study's objective of concentrating on Salmon River's water quality, eight sampling sites in the watershed were selected. Precipitation was collected on a bulk basis (wet and dry fallout). The same parameters measured for precipitation samples were analyzed for stream samples, the precipitation on Tug Hill appears to be at least as acidic as the rest of the northeastern United States and in many cases the annual hydrogen ion loading will be higher because of the quantity of precipitation in the area. The chemical and biological water quality of the streams in the Salmon River watershed is quite good and is capable of maintaining a diverse and productive macroinvertebrate community. The system does not appear to have been severely affected by acid rain to date and appears to be in no immediate danger; however, the system may experience long-term deterioration due to continued high acid inputs. Some short-term, event-associated decreases in stream pH were observed, but it is unlikely that these occurrences have cumulatively affected the biota. (Fazio-Omniplan)
W84-03658

FEDERAL PLAN FOR MITIGATION OF ACID PRECIPITATION EFFECTS IN THE UNITED STATES: OPPORTUNITIES FOR BASIC AND APPLIED RESEARCH,
For primary bibliographic entry see Field 6E.
W84-03812

SEQUENTIAL SAMPLING AND VARIABILITY OF ACID PRECIPITATION IN HAMPTON, VIRGINIA,
National Aeronautics and Space Administration, Hampton, VA. Langley Research Center.
G. L. Pellett, R. Bustin, and R. C. Harriss.
Water, Air, and Soil Pollution, Vol. 21, No. 1-4, p 33-49, January, 1984. 7 Fig, 3 Tab, 41 Ref.

Descriptors: *Acid rain, *Hampton, *Virginia, Air pollution, Fallout, Air pollution effects, Hydrogen ion concentration, Sulfate, Nitrate, Water pollution, Atmospheric physics, Chemistry of precipitation.

To resolve questions concerning the origin and ecological significance of acid precipitation, major research programs have been initiated in most regions of the world, including the development of nationwide and worldwide precipitation chemistry monitoring networks. Data was taken for a 3-year study of the intraevent volume-resolved variability of pH, sulfate, and nitrate in precipitation at a relatively isolated surburban site in Hampton, Virginia. Rain samples were collected sequentially by amount (approximately 2.7 mm each) from individual events. Rain pH's for $<$ or $=$ 3 mm samples closely fit a monomodal Gaussian distribution with a median of 4.50 and a standard deviation of 0.39. The variability in pH was primarily interevent as opposed to intraevent. The 3-yr volume-weighted

pH was 4.35 + or - 0.02 for 3.16 m collected; annual pH's were 4.31, 4.37, and 4.38, and cumulative H(+) deposition was 141 mg H(+)/sq m. Event-averaged rain pH and meteorological and air quality data were correlated. Low pH was associated with low rainfall volume and rate; rain after several dry days; rains with northeast surface winds; high SO2, NO2 and O3 in the ambient atmosphere; and high, strongly correlated, SO4(2-) and NO3(-) rainwater concentrations. The lowest 3-yr seasonal average pH (4.31) occurred during the summer; values for other seasons were approximately 4.37. It is considered climatologically significant that the volume-weighted H(+) concentrations of sequential samples, for all events, were very well characterized as a function of cumulative rainfall by a power-law fit (exponent = -0.22). Furthermore, as a consequence, event-averaged H(+) deposition varied as the 0.78 power of event volume. While the former result differs from the assumption of linear proportionality sometimes used in the literature, it deviates less from unity than a recent plot of MAP3S data on average SO4(2-) concentration per event, versus rainfall amount. (Murphy-IVI)
W84-03829

SUMMERTIME STUDY OF ACID DEPOSITION IN THE DETROIT AREA,
General Motors Research Labs., Warren, MI. Environmental Science Dept.
J. M. Dasch, S. H. Cadle, and G. T. Wolff.
Water, Air, and Soil Pollution, Vol. 21, No. 1-4, p 51-60, January, 1984. 9 Fig, 7 Tab, 23 Ref.

Descriptors: *Acid rain, *Detroit, Chemistry of precipitation, Hydrogen ion concentration, Atmospheric physics, Deposition, Warren, Lapeer, Michigan.

A comprehensive acid-deposition measuring (June-September 1981 period) station has been set up at the General Motors Technical Center site in Warren, Michigan. A second station is also being operated at a rural site near Lapeer, Michigan, which is approximately 54 km north of the Warren site. The rain composition was similar at both sites with the pH averaging 4.1 and the SO4(2-)/NO3(-) equivalence ratio averaging 2.1:1. This similarity suggests that local sources, i.e., relatively high emissions near the Warren site, and low emissions near the Lapeer site, have little effect on rain composition. The SO4(2-)/NO3(-) ratio for individual rain events in Warren reflected the SO2/NOx emission ratio in the area from which the event had come. Thus, the highest SO4(2-)/NO3(-) ratios were observed for rains that arrived from the southwesterly direction during this sampling period. Measurements were carried out at both sites to estimate the relative contribution of dry deposition. The ambient particulate was acidic about half the time and basic half the time. The acidity in the particulate was due to acid SO4(2-) and the basicity was due to soil-related materials. Gaseous HNO3 averaged 2.0 microg/cu m while the basic gas, NH3, averaged 0.83 microg/cu m. Based on these measurements, dry deposition of particles and HNO3 contributed less than 10% of the total deposition of acidity during this study period. (Murphy-IVI)
W84-03830

AEROSOL AND PRECIPITATION CHEMISTRY RELATIONSHIPS AT BIG BEND NATIONAL PARK,
Arizona Univ., Tucson. Dept. of Chemistry.
M. R. Derrick, J. L. Moyers, K. A. Yarborough, and M. Warren.
Water, Air, and Soil Pollution, Vol. 21, No. 1-4, p 171-181, January, 1984. 4 Fig, 3 Tab, 14 Ref.

Descriptors: *Aerosols, *Chemistry of precipitation, Air pollution effects, Sulfate, Nitrate, Ammonium, National Parks, Big Bend, Texas, Water pollution sources.

Aerosol chemistry, precipitation and visibility parameters are currently being measured at Big Bend National Park in Texas. This is part of a large-scale air resource evaluation program which the National Park Service is sponsoring in several southwestern national parks and monuments to determine the potential impact of local and distant pollutant sources on the environmental quality within these areas. Analysis of aerosol samples collected at six sites in the Southwest indicates that soil-derived components, organic materials and the acid-base ions of sulfate, nitrate, and ammonium are the major constituents of suspended airborne particulate matter in the remote areas of the arid region. Comparison of particulate matter chemistry and precipitation chemistry data at Big Bend National Park shows consistent features which indicate that the airborne alkaline soil material and NH3 largely neutralize the atmospheric acidic species of H2SO4 and HNO3. This buffering effect of the soil on the precipitation samples indicates that the impact of acidic precipitation on the ecosystem in the region is minimal. Given the similarity of the particulate matter composition and loading at the other monitoring sites, it is suggested that the trace chemical composition of precipitation will be similar in many remote regions of the Southwest. (Murphy-IVI)
W84-03832

CHEMICAL STRATIFICATION IN THE SENECA/OSWEGO RIVERS (NY),
Upstate Freshwater Inst., Syracuse, NY.
S. W. Effler, J. M. McCarthy, K. W. Simpson, F. J. Unangst, and G. C. Schafran.
Water, Air, and Soil Pollution, Vol. 21, No. 1-4, January, 1984. 7 Fig, 4 Tab, 22 Ref.

Descriptors: *Stratification, *Rivers, Seneca River, Oswego River, New York, Chemical reactions, River flow.

The occurrence and characteristics of chemically-based density stratification in portions of the Seneca and Oswego Rivers, downstream of ion-polluted Onondaga Lake, are described for seven different days in the summer and fall of 1978 and 1981, which covered a wide range of river flows. Chemically-based density stratification occurred routinely in the Seneca River downstream of the lake inflow, in response to a continuous chemically-based density difference between the two systems of 0.0015 to 0.0030 g/cu cm. The persistence of the phenomenon, and thus the longitudinal range over which the river stratification occurred, depended on the velocity of river flow and the magnitude of the density gradient that bordered the upper river water and the lower released lake water. The occurrence of chemical stratification in the river had dramatic implications on the corresponding distribution of dissolved oxygen (DO). The isolation of the organically enriched lake water in the lower layer enhanced the depletion of DO there, which resulted in the development of substantial DO stratification downstream of the discharge from the lake during summer low flow periods. (Baker-IVI)
W84-03836

FORMATION OF PERYLENE IN RECENT SEDIMENTS: KINETIC MODELS,
Indiana Univ. at Bloomington. School of Public and Environmental Affairs.
For primary bibliographic entry see Field 2J.
W84-03863

ROLE OF EQUILIBRIUM REACTIONS IN BORE-HOLE WATERS IN THE SKELLEFTEFIELD, NORTHERN SWEDEN,
Umea Univ. (Sweden). Dept. of Inorganic Chemistry.
J. Liden, and S. Sjoberg.
Nordic Hydrology, Vol. 14, No. 3, p 179-192, 1983. 5 Fig, 5 Tab, 26 Ref.

Descriptors: *Boreholes, *Water quality, *Skellefte Field, *Sweden, *Equilibrium reactions, Alkalinity, Acidity, Silicates, Iron, Sulfides, Chemical composition, Water analysis, Chemical reactions.

Measurements of pH and pe (in situ), main ionic constituents, silicic acid and aluminium were made in a series of bore holes in an acid-intermediate volcanite type rock. The bore holes covered the pH interval 6.5-8.6, each with a time invariant solution composition. Field data were used as an experimental test of computerized simulation of weathering reactions by means of equilibrium models. If the solution composition resulting from an equilibration between representative silicate minerals and pure water of P-CO2 corresponding to air is calculated, reasonable agreement is found with field data. These theoretical experiments suggest that in an undisturbed groundwater the primary silicate minerals tend to increase the pH to slightly alkaline values where the dissolved main components reach an irreversible saturation value. However, if the solution composition after an addition of protons is simulated by a stepwise decrease in pH, it is obvious that silicate minerals, including secondary clay minerals, react too slowly to control the ground water by means of any equilibrium reaction. Although a silicate mineral-water equilibrium obviously does not prevail in a system where pH has been decreased by the addition of protons, it is important to realize the strong pH-buffer that has to be crossed in order to convert for example a plagioclase to dissolved ions. As long as these primary silicates remain in the system, the pH will strive towards the alkaline side. (Baker-IVI)
W84-03986

2L. Estuaries

LIMNOLOGICAL STUDY OF SHASTA LAKE, SHASTA COUNTY, CALIFORNIA, WITH EMPHASIS ON THE EFFECTS OF THE 1977 DROUGHT,
Geological Survey, Menlo Park, CA. Water Resources Div.
S. A. Rettig, and G. C. Bortleson.
USGS Water-Resources Investigations Report 82-4081, April, 1983. 61 p, 24 Fig, 16 Tab, 15 Ref.

Descriptors: *Limnology, *Reservoirs, *Water quality, Nutrients, Biological properties, Chemical properties, Physical properties, Lake morphometry, *California, Shasta Lake, *Drought conditions, Hydrologic analysis.

An intensive limnological study of Shasta Lake was made in conjunction with the California Department of Water Resources during the 1977 drought. Water-quality data were collected from March 1977 through September 1978 at six lake stations and four lake tributary stations. Data collected during and after the drought were compared. Lake water quality is described as a function of lake morphometry, climate, hydrology, and reservoir hydraulics. Results indicate Shasta Lake is a warm monomictic lake. Tributary inflow to the lake and outflow through the dam generate density currents which promote mixing at depth and the development of an extensive metalimnion. During the drought, record low lake levels resulted in the exposure of an extensive nearshore sediment zone. Resuspended sediments caused a deterioration of water quality. The most notable effects, in comparison with post-drought conditions, were decreased light penetration, increased dissolved-solids concentration and specific conductance, decreased dissolved-oxygen concentrations, and elevated nutrient levels. A hypolimnetic anoxic condition was observed at the upstream stations of the lake. (USGS)
W84-03606

CONTRIBUTION TO THE PHYSICO-CHEMICAL LIMNOLOGY OF SWARTVLEI,
Rhodes Univ., Grahamstown (South Africa). Inst. of Freshwater Studies.
B. R. Allanson, and C. H. Williams.
Archiv fur Hydrobiologie, Vol. 99, No. 2, p 133-159, January, 1984. 15 Fig, 4 Tab, 37 Ref.

Descriptors: *Limnology, *Rivers, *South Africa, *Swartvlei, *Estuaries, Physical properties, Chemical properties, Lakes, Fulvic acid, Salinity, Meromixis, Wind.

Humate stained rivers caught up in lake basins of Pleistocene origin and connected to sinuous estuaries drain the coastal region of southern Africa in the vicinity of Knysna. The Swartvlei is the largest of these and provides an example of ectogenic

meromixis in South Africa. The lake is of low stability. Wind stress of 7.0 g cm/cm sq erodes the monimolimnion if the input of seawater is restricted by sandbars at the mouth of the estuary. The inflows of peat stained water dominate the light climate of the lake. This implies a high fulvic acid component easily degradable in the lake or estuary. While soluble reactive phosphate remains high in the anoxic monimolimnion, its transfer in significant quantities into the mixolimnion is prevented by the slow rate of erosion of the halocline during periods when the mouth of the estuary is closed. (Baker-IVI)
W84-03744

BACTERIAL PRODUCTION AND CARBON CONVERSION BASED ON SALTMARSH PLANT DEBRIS,
R. C. Newell, E. A. S. Linley, and M. I. Lucas.
Estuarine, Coastal and Shelf Science, Vol. 17, No. 4, p 405-419, October, 1983. 3 Fig, 3 Tab, 58 Ref. NIH grant ESO-1908.

Descriptors: *Bacteria, *Carbon cycle, *Salt marshes, Plant debris, Population dynamics, Ciliates, Choanoflagellates, Amoebae, Estuaries, Sediment-water interfaces.

There is a well-defined succession of micro-organisms which colonize powdered leaf debris from Spartina alterniflora and Funcus roemerianus, and aged natural detrital material when incubated in estuarine water at temperatures near to those recorded in the habitat at the time of collection. The natural assemblage of free-living bacteria in estuarine water rapidly enters logarithmic growth, subsequently declining with the increase in numbers of bactivorous microflagelates. These are then replaced by a mixed population of ciliates, choanoflagellates, amoeboid forms and attached bacteria which form part of a complex microbial community associated with particulate debris. The rate of increase of bacterial cells (micron), in both spring and summer experiments ranged from 0.010-0.108/h while estimates of bacterial carbon production ranged from 1.5 to 10.1 microg C/l/h, values which conform well with estimates obtained from natural assemblages of marine bacteria in coastal and estuarine waters elsewhere. Although both the ease of degradation of the detrital substrate and incubation temperature are of importance, enrichment of both powdered Spartina leaf debris and aged natural detritus with inorganic nutrients evidently enhances bacterial production under experimental conditions. In addition, the amount of carbon utilized to sustain bacterial carbon production shows a significant reduction following enrichment with NH4, NO3 or combinations of NO3 + PO4. The bacterial carbon conversion efficiency (microg C incorporated into bacterial production per microg C consumed) x 100, based on powdered Spartina leaves, and aged natural detritus, is thus increased from 9-14%, to as much as 38% in nutrient enriched media. Since NH4, NO3 and PO4 values are generally low in the water column, it seems likely that bacteria achieve a carbon conversion of only 9-14% on natural suspended detrital material, with the possibility of an enhanced conversion of up to 38% occurring at the sediment-water interface where ammonia regeneration occurs. This suggests that suspended bacteria which characterize estuarine waters of salt marsh areas may be responsible for the oxidation of 86-91% of the carbon which enters water column microheterotroph food chains, and are probably implicated in the large CO2 fluxes recently recorded from coastal wetland habitats. (Murphy-IVI)
W84-03804

NUTRIENTS AND PRIMARY PRODUCTION IN PERMANENTLY WELL-MIXED TEMPERATE COASTAL WATERS,
Brest Univ. (France). Station Biologique.
M. V. M. Wafar, P. Le Corre, and J. L. Birrien.
Estuarine, Coastal and Shelf Science, Vol. 17, No. 4, p 431-446, October, 1983. 9 Fig, 1 Tab, 35 Ref.

Descriptors: *Nutrients, *Primary production, *Meromixis, *Coastal waters, Hydrology, Seasonal cycles, France, English channel, Phytoplankton, Hydrologic regime.

Seasonal changes of nutrients and primary production were studied in Morlaix Bay (western English Channel) waters in 1979-1980. This region is characterized by strong tides and consequently the water column remains permanently well-mixed. Owing to this unique hydrological regime, primary production and nutrients follow seasonal cycles different from the classic temperate water cycles. Because of the instability of the water mass, phytoplankton development in spring is slow and attains a maximum only in summer. A minor autumnal primary production peak is absent. The slow development of phytoplankton results in a slow and prolonged utilization of nitrate and phosphate which attain their lowest values only at the end of summer. Predominance of diatoms in the spring phytoplankton results in a rapid utilization of silicon which reaches its lowest concentration as early as May. Ammonium shows a unique cycle in that it accumulates in the water column in spring-summer and is utilized by phytoplankton only when nitrate concentration is low. Nitrite changes show two peaks: a major peak in autumn associated with nitrogen remineralization and a minor peak in spring due to nitrite excretion by phytoplankton. Seasonal development of primary production in these waters is successively limited by silicon, nitrate and total inorganic nitrogen depletion in spring-summer before being eventually limited by light. This is substantiated by the seasonal changes of absolute C-14 assimilation values, solar energy utilization efficiency and assimilation number. Based on these results, it is hypothesized that the ratio between the depth of the euphotic zone and the depth of the water column will indicate whether light or nutrients limit primary productivity in well-mixed temperate waters. (Author's abstract)
W84-03805

CONSERVATIVE BEHAVIOUR OF BORON IN THE TAMAR ESTUARY,
Marine Biological Association of the United Kingdom, Plymouth (England).
M. I. Liddicoat, D. R. Turner, and M. Whitfield.
Estuarine, Coastal and Shelf Science, Vol. 17, No. 4, p 467-472, October, 1983. 3 Fig, 1 Tab, 8 Ref.

Descriptors: *Estuaries, *Boron, *Tamar Estuary, *England, Salinity, Alkalinity.

Thirteen surveys were made of the Tamar Estuary in southwest England during 1980-1982. On each survey surface samples were taken at approximately 3 0/00 salinity intervals between Devil's Point and the point at which the surface salinity fell below 0.5 0/00 (the salt wedge station). Above this point the sampling stations were spaced at 1 km intervals and extended to Weir Head. Each of the samples surveyed showed a conservative (straight line) relationship between boron concentration and salinity. Boron concentrations above the salt-wedge station were small and generally constant. The low concentrations observed in the freshwater end-members suggests that the dissolved boron in the estuary derives almost entirely from seawater. No evidence was found for the systematic addition or removal of boron within the estuary. It is unlikely that serious errors will be introduce into the alkalinity measurements in the Tamar Estuary by calculating the contributions of boron by the sample salinity. (Baker-IVI)
W84-03806

OXYGEN CONSUMPTION BY SEDIMENTS IN A SOUTHERN AFRICAN MANGROVE SWAMP,
Transkei Univ., Umtata (South Africa). Dept. of Zoology.
A. H. Dye.
Estuarine, Coastal and Shelf Science, Vol. 17, No. 4, p 473-478, October, 1983. 3 Fig, 1 Tab, 15 Ref.

Descriptors: *Oxygen requirements, *Sediments, *Mangroves, *Swamp, *South Africa, Mngazana estuary, Estuaries, Biological oxygen demand, Chemical oxygen demand.

Total, chemical and biological oxygen demand of intertidal sediment cores from 12 stations in a mangrove swamp in southern Africa were measured under mean temperature and salinity conditions. In addition to measuring oxygen removed from water overlying cores, the uptake of oxygen from air overlying sealed cores was also determined. Total oxygen consumption ranged from 2.9 to 37.0 ml O2/sq m/h in water and from 22.1 to 81.6 ml O2/sq m/h in air. Chemical oxygen demand usually equalled or exceeded the total, underlining problems in the measurement of this parameter. Since oxygen is not present below a few millimeters in the sediment, it is concluded that oxygen diffusing from the overlying water or air is rapidly utilized at the surface and its uptake rate does not give any measure of metabolic activity deeper down. The oxygen content of the overlying water present during high tide may drop to relatively low levels due to this demand. (Author's abstract)
W84-03807

BEHAVIOUR OF THE RARE EARTH ELEMENTS DURING MIXING OF RIVER AND SEA WATERS,
Cambridge Univ. (England). Dept. of Earth Sciences.
J. Hoyle, H. Elderfield, A. Gledhill, and M. Greaves.
Geochimica et Cosmochimica Acta, Vol. 48, No. 1, p 143-149, January, 1984. 6 Fig, 2 Tab, 20 Ref.

Descriptors: *Rare earth elements, *Rivers, *Seawater, *Mixing, *Water of Luce, *Scotland, Neodymium, Estuarine environment, Estuaries.

Rare earth element concentrations were measured in organic rich water from the Water of Luce, a river on the south-west corner of Scotland, and coastal sea water. Concentrations of about 350 to 1850 pmol/kg Nd were found in the water of the river and 45 to 350 pmol/kg Nd in Luce Bay. These concentrations were related to the presence of particles, with 30-60% of the rare earth elements (REE) associated with greater than 0.4-0.7 micrometer particles and to riverine Fe concentrations. REE fractionation occurred in the river water. The submicrometer river water was heavy with REE enrichment whereas the coarser fraction had a more shale-like REE pattern. Lab studies indicate that REE in organic-rich water are chiefly associated with Fe-organic matter colloids which flocculate during estuarine mixing. Preferential removal of heavy REE relative to light REE (95 to 60%) occurs, but no Ce anomaly is developed. In contrast, no REE removal occurs during estuarine mixing with organic-poor river water. (Baker-IVI)
W84-03865

EVALUATION OF A SEQUENTIAL EXTRACTION SCHEME TO STUDY ASSOCIATIONS OF TRACE ELEMENTS IN ESTUARINE AND OCEANIC SEDIMENTS,
Southampton Univ. (England). Dept. of Oceanography.
W. A. Maher.
Bulletin of Environmental Contamination and Toxicology, Vol. 32, No. 3, p 339-344, March, 1984. 2 Fig, 3 Tab, 7 Ref.

Descriptors: *Estuarine environment, *Sediments, *Trace elements, Estuaries, Sea water, Manganese, Iron, Aluminum, Organic compounds, Calcium carbonate, Carbonates, Silicon, Leaching.

Three deep sea sediments and three estuarine sediments were examined. To evaluate the optimum times for leaching the carbonate phase, sediment samples were first leached for one hour with 1 M magnesium chloride (pH 7), and then further leached with 1 M sodium acetate (pH 5), adjusted with acetic acid. The calcium concentrations were measured in the centrifuged supernatants at different time intervals. For all sediments, dissolution of calcium was complete within five hours. To evaluate the optimum time for reducing and dissolving iron and manganese oxides, sediment samples previously leached for exchangeable metals and carbonates were leached with the hydroxylamine hydrochloride-acetic acid reagent, and the iron content measured in the centrifuged supernatants at different time intervals. To assess the selectivity of each fraction, aluminium, calcium, iron, manganese

and silicon were determined in each extract. A sequential extraction scheme was found to be suitable for partitioning estuarine and oceanic sediments containing low organic carbon contents into major geochemical fractions. Due to the interaction of iron-manganese oxide phases and organic material, the selective dissolution of these fractions in organic rich sediments is not possible using the scheme outlined. (Baker-IVI)
W84-03877

PROCESS OF SEDIMENTATION ON THE SURFACE OF A SALT MARSH,
Delaware Univ., Newark. Coll. of Marine Studies.
For primary bibliographic entry see Field 2J.
W84-03897

NITROGEN LOSS FROM FRESHWATER AND SALINE ESTUARINE SEDIMENTS,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
For primary bibliographic entry see Field 2H.
W84-03929

CHESAPEAKE BAY NUTRIENT AND PLANKTON DYNAMICS. 2. SOURCES AND SINKS OF NITRITE,
Harvard Univ., Cambridge, MA. Museum of Comparative Zoology.
J. M. McCarthy, W. Kaplan, and J. L. Nevins.
Limnology and Oceanography, Vol. 29, No. 1, p 84-98, January, 1984. 8 Fig, 3 Tab, 41 Ref.

Descriptors: *Bays, *Nutrients, *Nitrites, *Chesapeake Bay, Water pollution sources, Nitrates, Ammonia, York River, Chemical analysis, Estuaries.

A combination of N-13 tracer techniques and assays of the concentrations of chemical constituents were used to investigate the transformations of inorganic nitrogenous nutrients that can lead to the frequently observed high levels of nitrite in the Chesapeake Bay and York River. Uptake and remineralization of NH4(+) in the York River during destratification followed a diel cycle. Nitrification was not as closely coupled to the light regime. The primary source of N2O and NO2(-) appeared to be in the water rather than in the sediments. The N-15 data indicated that oxidized N could be formed in the water of the bay when physical events caused the mixing of NH4(+)-rich bottom water with more oxygenated surface layers. Also, the NO3(-) was reduced to NH4(+) at unexpectedly rapid rates in well oxygenated surface waters. The magnitude and duration of high concentrations of N2O and NO2(-) in these estuarine waters during mixing events might be expected to increase if anthropogenic loading of nutrients causes anoxic conditions in the bay to become more widespread. (Baker-IVI)
W84-03962

ABOVEGROUND AND BELOWGROUND PRIMARY PRODUCTION DYNAMICS OF TWO DELAWARE BAY TIDAL MARSHES,
Delaware Univ., Newark. Coll. of Marine Studies.
C. T. Roman, and F. C. Daiber.
Bulletin of the Torrey Botanical Club, Vol. III, No. 1, p 34-41, January-March, 1984. 3 Fig, 5 Tab, 29 Ref.

Descriptors: *Primary productivity, *Aboveground, *Belowground, *Delaware Bay, *Tidal marshes, Angiosperms, Carbon cycle, Nitrogen cycle, Canary Creek, Blackbird Creek.

Aboveground and belowground net primary productivity estimates of the dominant angiosperm from two tidal marshes along the Delaware Bay estuary including ash, carbon and nitrogen content were determined. Annual net aboveground production was determined by the peak live standing crop method and the Smalley method. Aerial production of tall Spartina alterniflora Loisel. at the Canary Creek salt marsh, employing the Smalley technique was 1487 g/sq m/yr, while production of short S. alterniflora, S. patens (Ait.) Muhl. and Distichlis spicata (L.) Greene was, 654 g/sq m/yr, 1147 g/sq m/yr, and 785 g/sq m/yr, respectively. At the brackish water Blackbird Creek marsh, Phragmites australis (Cav.) Trin. had the highest aboveground production (2940 g/sq m/yr), followed by S. patens (1089 g/sq m/yr) and short S. alterniflora (916 g/sq m/yr). Belowground primary production was determined by the annual increment (max-min) method, with respective estimates of 6.5 kg/sq/m/yr, 5.0 kg/sq m/yr, and 3.3 kg/sq m/yr, for tall S. alterniflora, short S. alterniflora and S. patens, at the Canary Creek marsh. Belowground estimates at the Blackbird Creek marsh were within this range. (Murphy-IVI)
W84-04006

TRANSPORT AND DISTRIBUTION OF NUTRIENTS IN THE LOXAHATCHEE RIVER ESTUARY, SOUTHEASTERN FLORIDA, 1979-81,
Malawi Water Resources Div., Lilongwe.
B. F. McPherson, and W. H. Sonntag.
Water Resources Bulletin, Vol. 20, No. 1, p 27-34, February, 1984. 4 Fig, 4 Tab, 16 Ref.

Descriptors: *Estuaries, *Nutrients, *Loxahatchee River Estuary, *Florida, Nitrogen, Phosphorus, Organic carbon, Mixing, Seawater, Storm runoff, Tidal flushing, Salinity, Tropical cyclones.

Concentrations of total nitrogen, total phosphorus, and total organic carbon in the Loxahatchee River estuary decreased with increasing salinity in a manner indicating that mixing and dilution of freshwater by seawater was the primary process controlling the downstream concentrations of nutrients. Most of the nutrients in the surface freshwater inflows entered the estuary from five major tributaries; however, about 10% of the total nitrogen and 32% of the total phosphorus were from urban stormwater runoff. The input of nutrients was highly seasonal and storm related. During a 61-day period of above average rainfall that included Tropical Storm Dennis, the major tributaries discharged 2.7 metric tons of total phosphorus, 75 metric tons of total nitrogen, and 1,000 metric tons of organic carbon to the estuary. This period accounted for more than half of the total nutrient load from the major tributaries during the 1981 water year (October 1, 1980, through September 30, 1981). Inorganic phosphorus and nitrogen increased relative to total phosphorus and nitrogen during storm runoff. Nutrient yield from the basin, expressed as grams per square meter of basin area, was relatively low. However, because the basin area (544 sq km) is large compared with the volume of the estuary, the basin might be expected to contribute significantly to estuarine enrichment were if not for tidal flushing. Approximately 60% of the total volume of the estuary is flushed on each tide. Because the estuary is well flushed, it probably has a large tolerance for nutrient loading. (Author's abstract)
W84-04101

PLANT GROWTH ON EXPERIMENTAL ISLAND BEDS AND NITROGEN UPTAKE FROM SURROUNDING WATER,
Papua New Guinea Univ., Port Moresby. Dept. of History.
D. E. Vasey.
Agriculture, Ecosystems and Environment, Vol. 10, No. 1, p 15-22, August, 1983. 1 Tab, 24 Ref.

Descriptors: *Nitrogen, *Island beds, *Raised beds, *Plant growth, Cultivation, Wetlands, Algae, Eutrophication.

An ancient method of preparing wetlands for cultivation consists of moving earth to form raised planting surfaces which are surrounded by water for all or part of the year. Revivals of the system are aimed at providing insights into prehistory, restoring traditional intensive methods, and adapting the system to modern agricultural technology and commercial economies. Experimentation was begun in 1980 to determine the paths by which combined nitrogen present in the surrounding channels might become available to crops on the beds. The potential contribution of combined N from the water to crops on island beds and raised fields could be substantial, if conditions favor biological N-fixation and appropriate means of transferring organic matter and combined N are developed. Total N reached much higher levels in artificial ponds exposed to sunlight than in completely shaded ponds, and yet Para grass, planted in pots that allowed the roots to extend through to the ponds, made significantly more growth in the shaded ponds than in the sunny ponds. The test crop could not complete effectively for N with algae, and N in surrounding eutrophic bodies of water is readily available to crops on island beds only if the crop roots reach channel sediments, or organic matter is transferred form the channels to the beds. (Moore-IVI)
W84-04112

DEVELOPMENT OF BENTHIC COMMUNITIES ON NEW BREAKWATERS,
Institute of Biology of the Southern Seas, Sevastopol (USSR).
O. G. Mironov, N. Yu. Milovodova, and I. M. Tsymbal.
Hydrobiological Journal, Vol. 19, No. 1, p 49-53, 1983. 2 Fig, 1 Tab, 5 Ref.

Descriptors: *Benthic environment, *Piers, Breakwaters, Hydrobiology, Black Sea, Algae growth, Substrates, Stones.

Quantitative characteristics are presented for phyto- and zoobenthos populating newly erected pier structures. It is established that the phyto- and zoobenthos are similar in qualitative and quantitative respect to natural ones. Biocenoses of pier structures differ in a series of specific peculiarities connected with the period of their formation. The complex of animal forms populating the stones in the breakwaters which have been described is quantitatively similar to that found on the natural stones of Novorossiysk Bay, but less varied than that on the stones of the open parts of the Caucasian and Crimean coastlines. Accordingly, even during the first years of their existence, manmade stone marine structures become covered with a relatively thick biofilter resembling the natural biofilter of natural stone substrates. (Baker-IVI)
W84-04134

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3B. Water Yield Improvement

VIRUSES IN GROUNDWATER BENEATH SEWAGE IRRIGATED CROPLAND,
Minnesota Univ., St. Paul. Coll. of Veterinary Medicine.
For primary bibliographic entry see Field 5B.
W84-03731

HYDROGEOLOGY FOR LAND-USE PLANNING: THE PETERS CREEK AREA, MUNICIPALITY OF ANCHORAGE, ALASAKA,
Geological Survey, Anchorage, AK. Water Resources Div.
J. O. Brunett, and M. Lee.
USGS Water-Resources Investigations Report 82-4120, 1982. 6 p, 14 Fig, 2 Tab, 23 Ref.

Descriptors: *Groundwater, *Geohydrologic units, Groundwater, Wetlands, Streamflow, Drainage, Erosion, Water quality, Water pollution, Sewage disposal, Water supply, Landslope, *Land-use planning, *Alaska, Anchorage, Peters Creek, Chugach Mountains, Knik Arm, Fire Lake, Chugiah, Birchwood, Eklutna.

Wells currently provide all water supplies in the area. Most wells obtain enough water for individual household needs from unconsolidated, principally glacial and glaciolluvial deposits. In some places, however, wells must be drilled into the underlying bedrock to obtain adequate supplies. It may be possible to develop small community supplies--for individual trailer courts or subdivisions--in areas where yields of 20 gallons per minute or greater are reported for private, domestic wells. Peters Creek is a potential source of surface-water

supply, but it would have to be treated to remove glacial silt during summer months. The chemical quality of both ground water and surface water in the area in generally acceptable for most uses. Foundation and excavation conditions, the potential for water pollution from onsite disposal of wastewater through septic tank systems, and the suitability of specific areas for certain types of development may be affected by the following factors: wetlands and areas of shallow ground water underlie about 30 percent of the study area; landslope exceeds 20 percent in about a third of the area; areas of fine-grained, low-permeability sediments are present locally; bedrock is within 25 feet of the land surface in about a third of the area. (USGS)
W84-03858

EVAPORATION REDUCTION: SUMMARY OF LONG-TERM TANK STUDIES,
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
K. R. Cooley.
Journal of Irrigation and Drainage Engineering, Vol. 109, No. 1, p 89-98, March, 1983. 1 Fig, 4 Tab, 18 Ref.

Descriptors: *Evaporation, *Evaporation control, Floating covers, Cost analysis, Cost-benefit analysis, Reservoir evaporation, Water conservation.

Conserving water contained in existing storage facilities, is in some situations, the most economical means of providing adequate water supplies. A review of evaporation reduction studies indicated that shades suspended above a water surface and floating covers on a water surface gave best results. Of the two, floating covers were most practical. Field tests using floating covers of foamed wax blocks, continuous wax, and foamed rubber reduced evaporation losses 36%-84% over an 8 yr period. Based on the amount of the water saved and the cost of materials used, the continuous wax covers provided the lowest cost water at $0.08 to $0.13/1,000 L/yr, followed by foamed rubber and foamed wax blocks at $0.17 and $0.18 per 1,000 L/yr, respectively. However, evaporation reduction efficiency of the continuous wax covers began to decrease after a few years of exposure, while the foamed rubber and foamed wax blocks showed no signs of deterioration. Long-term durability, efficiency, and climatic range of usability should be considered along with costs when determining the most practical cover to use. (Murphy-IVI)
W84-04039

GUIDELINES FOR CLOUD SEEDING TO AUGMENT PRECIPITATION.
Journal of Irrigation and Drainage Engineering, Vol. 109, No. 1, p 111-182, March, 1983. 14 Fig, 1 Tab, 94 Ref, 2 Append.

Descriptors: *Cloud seeding, *Weather modification, *Water resources development, Environmental effects, Social aspects, Economic aspects, Feasibility, Legal aspects, Cost-benefit analysis.

The guidelines for implementing weather modification are intended to provide water resources managers with information and references that they may need to make a decision on the use of weather modification to augment available water supplies. The sections cover a variety of aspects of weather modification including the social, legal, environmental and economic issues as well as the scientific basis. The scientific basis for cloud seeding to augment precipitation rests on the assumptions that natural cloud precipitation can be increased (static seeding) or that cloud development can be enhanced (dynamic seeding) to produce bigger clouds. The augmentation possible is fractional, in the range of 5-20%; this much additional over the farm belt would be helpful to agriculture, and the addition over mountainous terrain would benefit the hydroelectric power industry and irrigation interests. The technical details of various devices for producing artificial nuclei, and the various methods for distributing the artificial nuclei through cloud masses are described in detail. The type of generating system employed and its mode of operation depends upon the type of cloud systems that are to be treated. Initial steps toward implementing a seeding program include consideration of the need for augmented precipitation, how it would be used and alternative approaches. A feasibility study is desirable and should include a clear statement of all objectives of the proposed project. A design study should include review of objectives vs. time, statements of program goals, alternative plans, and longer term aspects. The risks and costs must be estimated as thoroughly as are the benefits. (Moore-IVI)
W84-04041

3C. Use Of Water Of Impaired Quality

REACTIONS OF HEAVY METALS AND OTHER MINERAL WATER QUALITY CONSTITUENTS WITH SOIL MATERIALS IN RAPID INFILTRATION GROUNDWATER RECHARGE SYSTEMS USING RECLAIMED WASTEWATERS,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 4B.
W84-03697

NITROGEN AVAILABILITY FROM POTATO-PROCESSING WASTEWATER FOR GROWING CORN,
Agricultural Research Service, Kimberly, ID. Snake River Conservation Research Center.
J. H. Smith, and C. W. Hayden.
Journal of Environmental Quality, Vol. 13, No. 1, p 151-156, 1984. 10 Tab, 11 Ref.

Descriptors: *Nitrogen, *Potato-processing wastewater, *Corn, Sprinkler irrigation, Irrigation effects, Wastewater disposal, Water reuse, Corn yield, Wastewater irrigation, Caldwell, Idaho.

Irrigating with food-processing wastewater for growing crops is an established practice used by a large segment of the food processing industry. In many existing systems, emphasis has been placed on disposing of wastewater with maximum applications of both the wastewater and included plant nutrients. A line source sprinkler was used to irrigate corn (Zea mays L.) plots with potato (Solanum tuberosum L.)-processing wastewater in 1979, 1980, and 1981. Nitrogen applications ranged from about 4 to 600 kg/ha. Corn yields were measured for each row, the grain and stalks were analyzed for total N, and N uptake was calculated. The plots were split by years, one-third of the area was fertilized with wastewater 3 y, one-third 2 y, and one-third 1 y. This allowed evaluation of current and residual value of wastewater fertilization. Corn responded well to wastewater fertilization, with N applications in the wastewater increasing corn yields with increasing increments of N up to about 200 to 250 kg/ha annually, and corn grain yields ranged up to about 12 Mg/ha. Yield comparisons were made with plots fertilized with ammonium nitrate fertilizer. We determined that potato-processing wastewater N was almost equal to ammonium nitrate N for growing corn. Wastewater applications that will apply approximately 200 to 250 kg N/ha annually should be optimum for growing corn on this soil. Wastewater N from potato processing has good residual and carry-over for 1 y but under conditions of this experiment did not carry over for more than 1 y. Whether the excess N was lost from denitrification or leaching was not determined. (Murphy-IVI)
W84-03948

3D. Conservation In Domestic and Municipal Use

SURVEY OF STATE WATER CONSERVATION PROGRAMS IN THE U.S.,
Georgia Inst. of Tech., Atlanta. Coll. of Architecture.
For primary bibliographic entry see Field 3F.
W84-04106

3E. Conservation In Industry

RECENT ADVANCES IN TITANIUM DIOXIDE RECOVERY, FILLER RETENTION AND WHITE WATER TREATMENT,
Lenox Inst. for Research, Inc., MA.
For primary bibliographic entry see Field 5D.
W84-03672

3F. Conservation In Agriculture

PRICING AND CONSERVATION OF IRRIGATION WATER IN TEXAS AND NEW MEXICO,
Texas A and M Univ., College Station. Water Resources Inst.
For primary bibliographic entry see Field 6B.
W84-03570

LAND CONSOLIDATION IN IRRIGATION PROJECTS,
International Bank for Reconstruction and Development, Washington, DC. East Asian and Pacific Projects Dept.
H. L. Plusquellec.
Journal of Irrigation and Drainage Engineering, Vol. 109, No. 1, p 99-110, March, 1983. 4 Fig, 2 Ref.

Descriptors: *Irrigation programs, *Rational layout, *Water distribution, *Land consolidation, Surface irrigation, Sprinkler irrigation, Irrigation efficiency, Crop yield, Farming, Developing countries.

A model for land consolidation and the layout of irrigation systems was developed in Morocco about 20 yr ago and has been used widely there ever since. Known as the 'rational layout' scheme, this approach facilitates modern farming activities and rotational water distribution in areas with diversified agriculture and small land parcels. Rational layout represents a fusion of two other approaches to irrigation layout which were tested individually with less success: (1) an agriculturist's approach emphasizing modern farming principles, particularly collective plowing; and (2) an engineering approach which provides a permanent consolidated on-farm irrigation network, including irrigation ditches, drainage channels and farm roads. The rational layout scheme is unique in dealing with the various factors that must be considered in regrouping separate small plots into consolidated areas for irrigation. These include irregular plot size, surface or sprinkler irrigation systems, crop diversification, crop rotation, and agricultural mechanization. Areas using this system have shown increased irrigation efficiency, higher yields and cropping intensity, and increased use of modern agricultural practice. (Author's abstract)
W84-04040

IRRIGATION WATER DELIVERY PERFORMANCE,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
A. J. Clemmens, and A. R. Dedrick.
Journal of Irrigation and Drainage Engineering, Vol. 110, No. 1, p 1-13, March, 1984. 5 Fig, 1 Tab, 15 Ref.

Descriptors: *Irrigation water, *Water delivery, *Colorado River Indian Reservation, *LaPaz county, *Arizona, Water conveyance, Water use, Flow rate, Variability.

Data were collected from sites on the Colorado River Indian Reservation, LaPaz county, Arizona, in 1980 and 1981. Twenty delivery sites within the irrigation district were monitored in order to determine the amount of variability in flow rate during each water delivery. The coefficient of variation (CV) of instantaneous (1/2 hour) flow rate values averaged for each turnout ranged from 0.04-0.29. CV was related to the location of the site within the delivery system. Time of year, flow rate, and crops grown did not appear to affect CV. On-farm water use is affected by the level of delivery flexi-

bility and the uniformity of water deliveries. Upgrading of farm irrigation systems may require improvements in delivery flexibility and uniformity. Increasing the delivery flexibility may result in less uniform deliveries, which may also reduce the operational conveyance efficiency of the delivery system unless the system is also upgraded. Delivery system performance can be improved by such structural measures as the addition of measuring devices, canal control devices, improved turnout sturctures, or reservoirs. Nonstructural (management) changes can have an equally important effect. A change of attitude is usually required by both water users and district personnel if effective improvement in system performance is to be attained. (Moore-IVI)
W84-04089

SUITABILITY OF REDUCED PRESSURE CENTER-PIVOTS,
Nebraska Univ., Lincoln. Dept. of Agricultural Engineering.
J. R. Gilley.
Journal of Irrigation and Drainage Engineering, Vol. 110, No. 1, p 22-34, March, 1984. 7 Fig, 5 Tab, 14 Ref.

Descriptors: *Irrigation, *Center pivot irrigation, *Reduced pressure, *Runoff, Soil properties, Sprinkler irrigation, Irrigation depth.

Reduced pressure center-pivot systems, using spray nozzles or low-pressure impact sprinklers, are becoming popular and many existing high pressure systems are being retrofitted with reduced pressure devices. Reduced pressure systems can be operated at pivot pressures approaching 130-200 kPa, resulting in considerable energy savings. Selection criteria are developed for reduced pressure center-pivot irrigation systems. The combined effects of the application rate characteristics of center-pivot irrigation systems and the soil intake family curves were analyzed to determine the maximum depth of water which could be applied per irrigation for various types of soils and sprinkler packages. The irrigation depths are used to determine guidelines for proper selection of reduced pressure center-pivot systems. The results can be used as a general guide to determine if a particular system may have a runoff problem under a given situation. The maximum irrigation depth which may be applied without any potential runoff may be too small for some systems to provide an acceptable irrigation amount, and therefore should not be used in that particular location. (Moore-IVI)
W84-04091

STATUS OF IRRIGATION AND DRAINAGE RESEARCH IN THE UNITED STATES.
For primary bibliographic entry see Field 7A.
W84-04094

SURVEY OF STATE WATER CONSERVATION PROGRAMS IN THE U.S.,
Georgia Inst. of Tech., Atlanta. Coll. of Architecture.
T. N. Debo, and N. Rogers.
Water Resources Bulletin, Vol. 20, No. 1, p 67-74, February, 1984. 1 Fig, 1 Tab, 1 Append.

Descriptors: *Water conservation, *State jurisdiction, Legal aspects, Education, Drought.

Adequate water supplies are critical to the maintenance of a community's health and economic well-being. As the demand grows and communities actively compete with one another for a limited water supply, states are being called upon to help solve the problem. One solution being used in many areas is the development and implementation of a water conservation program. Using a mailed survey, state water conservation programs and some of the characteristics of the different programs were documented. Responses to the nationwide survey were obtained from all 50 states. The specific water conservation program elements on which information was received from the survey included laws and restricted use, community assistance, education, research, and other services. Eighteen of the 50 states indicated in the survey that they had some level of a water conservation program in operation. The need for state level programs was expressed by at least 36 states. Eighteen states indicated they have programs under development or study at the time of the survey. In addition to the states that are developing or have water conservation programs, seven states have emergency or drought water conservation programs. Seven other states have plans for emergency programs in addition to their operating programs. The 36 states which have either established a water conservation program, are developing programs, or are studying the issue should act as valuable resources for one another and the remaining states to meet the water supply needs of the future. (Moore-IVI)
W84-04106

INTRODUCING INFILTRATING IRRIGATION TECHNOLOGY.
Irrigation Journal, Vol. 33, No. 3, p 14-16, May/June, 1983. 4 Fig.

Descriptors: *Water supply development, *Irrigation, *Saline water, Infiltrating Irrigation Technology, Irrigation plans, Water supply.

An infiltrating irrigation technology (IIT) device is presented which prevents salt damage to soil. The IIT is designed to let the irrigation water abide in the soil by using the absorbing nature of soil. According to the IIT theory, the salt contained in irrigation water naturally concentrates around the emitter. Therefore, the moistened area within the soil can be automatically receiving desalted water. In tests where irrigation was performed with saline water incessantly for 11 days using IIT under a speed of 0.62 cc/min (about 990 cc/day), the IIT proved to be a simple structure capable of using water which had not been applicable as irrigation water prior to that time. (Baker-IVI)
W84-04138

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

REPORT OF THE RIVER MASTER OF THE DELAWARE RIVER FOR THE PERIOD DECEMBER 1, 1981 - NOVEMBER 30, 1982,
Geological Survey, Trenton, NJ. Water Resources Div.
F. T. Schaefer, and R. E. Fish.
USGS Open-File Report 83-538, 1982. 91 p, 7 Fig, 19 Tab, 2 Ref.

Descriptors: *Delaware River, Diversion, Release, *Water management, Drought, *Reservoir yield, *Regulation, Supply, Inter-basin transfers, *River Master Report.

The Amended Decree of the Supreme Court of the United States in 1954 established the position of Delaware River Master to administer provisions of the decree relative to diversions from the Delaware by the City of New York and the State of New Jersey, and releases from reservoirs of the City of New York designed to maintain stipulated rates of flow in the river. Reports to the Court, not less frequently than annually, with copies to the Governors and the Mayor, were stipulated. Water-supply conditions at the beginning of the year were under a status of emergency resulting from drought, which had been declared by the Delaware River Basin Commission. With the filling of the reservoirs, the emergency was lifted April 27. Runoff of Delaware River at Montague, New Jersey, was 19 percent below median during the year as compared to 28 percent below median the previous year. By November, with reservoir storage again declining, reductions in both diversions and releases were imposed. To conserve supplies, reductions were effected on November 13 limiting New York City diversions at 680 mgd and New Jersey to 85 mgd, and the required discharge at Montague was targeted at 1,655 cfs. Water quality of the Delaware River and Estuary was monitored on a continuous basis at six sites for most of the year and on a monthly basis at ten sites to accurately locate the salt front. Highest chloride concentration observed at the Chester, PA, site was 870 mg/l November 4. (USGS)
W84-03578

FLOOD OF JUNE 15, 1981, IN GREAT BEND AND VICINITY, CENTRAL KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 2E.
W84-03855

TILLAGE SYSTEM AND RESIDUE COVER EFFECTS ON INFILTRATION IN NORTHWESTERN CORN BELT SOILS,
Agricultural Research Service, Morris, MN.
M. J. Lindstron, W. B. Voorhees, and C. A. Onstad.
Journal of Soil and Water Conservation, Vol. 39, No. 1, p 64-68, January-February, 1984. 4 Fig, 2 Tab, 19 Ref.

Descriptors: *Tillage, *Residue cover, *Infiltration, Rainfall-runoff relationships, Agricultural runoff, Runoff rates, Runoff volume, Soil physical properties, Hydraulic conductivity, Rainfall energy.

Some reports indicate that tillage systems leaving residue on the soil surface will reduce runoff and erosion. Other reports, however, indicate that surface residue does not always reduce runoff, particularly in no-till systems. The conflict in these reports indicates that other factors, in combination with surface residue, must influence infiltration rate and runoff potential. Simulated rainfall trials were conducted in wheel-tracked and nonwheel-tracked interrows for conventional, reduced, and no-till cropping systems immediately after planting during the first and tenth years of continuous corn. Results showed that (a) tractor wheel-traced interrows were vulnerable to runoff regardless of tillage system and (b) infiltration declined after runoff started. Runoff occurred quickly on the no-till, nonwheel-tracked interrow, indicating the presence of some infiltration restricting factor(s). Bulk density, penetrometer resistance, saturated hydraulic conductivity, and pore-size distribution were measured during the third crop year of continuous corn to determine soil physical properties that developed with tillage systems and the effect these properties had on infiltration. The no-till treatment-modified in this trial by cultivation during the previous growing season to form ridges - was characterized by a higher bulk density, greater penetrometer resistance, reduced saturated hydraulic conductivity, and a lower volume of macropores. The no-till treatment exhibited reduced infiltration. Surface crop residue effectively increased the rainfall energy required to start runoff under the reduced tillage system, but residue had no effect when soil surface conditions (no-till and wheel-tracked interrows) had developed that restricted water movement into the soil. (Murphy-IVI)
W84-03868

PRACTICAL APPLICATIONS OF A SHADING MATERIAL FOR MACROPHYTE CONTROL IN WATERCOURSES,
Freshwater Biological Association, Wareham (England). River Lab.
F. H. Dawson, and H. B. Hallows.
Aquatic Botany, Vol. 17, No. 3/4, p 301-308, December, 1983. 2 Fig, 1 Tab, 10 Ref.

Descriptors: *Rooted aquatic plants, *Aquatic weed control, *Shading, Macrophytes, Ranunculus, Nasturtium, Apium, Elodea, Sparganuim, Phragmites.

Typar, a light-weight gas-permeable opaque spunbonded polypropylene was used for the control of rooted macrophytes in flowing waters in areas

normally subject to mechanical control. The material has a relatively high tensile strength and resistance to mechanical penetration; this black-colored light-weight grade reduced the passage of light by approximately 70%. Submerged macrophytes were more rapidly controlled than emergent ones, primarily because the build up of detritus on submersed material reduced the light penetration. The period required for control varied: Ranunculus penicillatus var. calcareus, 5-8 weeks; Nasturtium officinale and Apium nodiflorum, 6-9 weeks; Elodea spp., Sparganium erectum and Phragmites australis, 12 weeks. Shorter periods give partial control whereas extended periods require macrophytes to reinvade controlled sites. This technique, i.e., the planned cycle of movement of material during the plant growing season, is considered economically competitive with other methods and could be applied to a wide variety of sites currently being managed by techniques which stress the biological system. Shaded material may be aesthetically displeasing but it does avoid excessive or rapid stress typical of mechanical control and it does not contaminate the stream system. It is local in action, reliable in effect and can give firm control of rooted macrophytes without eradicating them. Shading material may be particularly suitable for sensitive areas such as nature preserves and special interest sites and also for areas in need of constant local plant control, such as gaging weirs and in fisheries. (Moore-IVI)
W84-04118

4B. Groundwater Management

PROTECTION UNLIMITED: A PREFERRED USER'S RIGHT TO MEANS OF GROUNDWATER DIVERSION IN NEBRASKA,
For primary bibliographic entry see Field 6E.
W84-03535

ARTIFICIAL RECHARGE IN THE NORTHERN PART OF CHINO GROUND-WATER BASIN, UPPER SANTA ANA VALLEY, CALIFORNIA,
Geological Survey, Menlo Park, CA. Water Resources Div.
J. H. Koehler.
USGS Water-Resources Investigations Report 82-4122, June, 1983. 23 p, 7 Fig, 4 Tab, 6 Ref.

Descriptors: Water resources, Hydrology, Geology, Drillers' logs, Precipitation, *Groundwater, *Artificial recharge, Infiltration rate, *California, Chino basin.

This study was made to help management design and implement a recharge-recapture system for State Water Project water in Chino Basin. Nine test holes were drilled in the study area. Analyses of data from these test holes and drillers' logs of water wells indicate the presence of clay deposits. The clay deposits cannot be correlated between holes which indicates that they are in the form of discontinuous beds or lenses. The existence and location of two ground-water barriers (Barrier 'J' and Red Hill Barrier) have been postulated in previous reports. Water-level data indicate that Barrier 'J' is probably not effectively stopping the movement of ground water. Data are insufficient to determine the effectiveness of the Red Hill barrier. Five existing recharge facilities in the study area were previously constructed to control floodflow. Infiltration tests were conducted at three of the facilities, and results of these tests indicate infiltration rates of 2.6 feet per day at Day Creek, 2.0 feet per day at East Etiwanda, and 1.3 feet per day at San Sevaine. A total of about 9,000 acre-feet of State Water Project water was recharged between June 1980 and July 1981. Rising water levels in wells indicate that recharge water is percolating down to the water table. (USGS)
W84-03584

GROUNDWATER MANAGEMENT PLANNING,
Disko (M.) Associates, Union, NJ.
M. Disko, D. Nusser, and E. Doheny.
Report, April 1978. 410 p, 66 Fig, 40 Tab.

Descriptors: *Groundwater management, *Potable water, *Permeability, *Water rights, *Groundwater inventory, Tourism, Drinking water, Domestic water, Surface-groundwater relations, Pumping tests, Legal aspects, Subsurface water, Recreation.

All of the potable water consumed in Orange County, New Jersey comes from groundwater. Increasing population and industrial development throughout the county, accompanied by the inevitable lowering of surface water quality, make the groundwater supplies all the more valuable. Industrial manufacturing and agriculture is at present of relatively minor importance in the county, while the largest influx of revenues is provided by the seasonal tourist industry, which is geared to bathers, boaters, fishermen and other sports enthusiasts. Ocean County is drained principally by east and southwest flowing consequent streams of the coastal drainage area. The streams exhibit an essentially uniform dentritic drainage pattern due to the relatively uniform nature of the underlying material. Calculations of permeability were performed for wells in the 208 Planning Area where the necessary pumping test data were available. Permeabilities ranged from 105 to 4,363 gpd/sq. ft., with an average value of approximately 1,900 gpd/sq. ft. This is somewhat higher than values determined in past studies. New Jersey law provides for the diversion of subsurface water on an allocation basis for both public and private uses. Certain wells have pump capacities less than 70 gpm, while the Lakehurst Naval Air Station and the Glidden-Durkee Company in Lakehurst divert groundwater in excess of 100,000 gpm without a permit because of 'grandfather rights'. No groundwater contamination is in the area that threatens water quality. (Garrison-Omniplan)
W84-03676

TUG HILL AQUIFER: PLANNING AND EDUCATIONAL NEEDS,
Cornell Univ., Ithaca, NY. Center for Environmental Research.
H. B. Hughes and K. S. Porter.
Report, 1980. 40 p, 7 Fig, 1 Tab, 2 Ref, 2 Append.

Descriptors: *Aquifer management, *Aquifer characteristics, *Stream discharge, *Projections, *Pollutants, *Education, Saturation zone, Public participation, Long-term planning, Social participation, Regional development, Chemical wastes Citizen participation.

To identify and evaluate management strategies for the use and protection of the Tug Hill Aquifer in upstate New York, specific aims were developed including technical methods for planning and management, and the preparation and dissemination of readily usable information for local residents. The proposed steps to carry out these aims include an update of land use data, construction of a water budget for the area, drilling test wells, collecting samples for baseline quality, analyzing present and future risks with contaminant budgets, measuring gain loss streamflow, analyzing water for specific contaminants of concern, producing community education products, producing maps and reports about the saturated zone and interactions with streams, and producing a manual for evaluating situations of opportunity or potential threat. These steps could be done in four phases: (1) determining catchment of wells and maximum time of contaminant travel; (2) building a mathematical model for water and contaminants near the surface; (3) diagnosing existing problems, if any; and (4) examining the implications of present and future conditions. Because of the need to allow for any uncertainties involved in doing contaminant budgets for hazardous chemicals in consumer products, a planner might suggest modification to a plan for a major development in a well catchment of a water supply well. The educational aspect of the project can be handled using public meetings, field trips, a guidebook, and microcomputers. (Garrison-Omniplan)
W84-03691

REACTIONS OF HEAVY METALS AND OTHER MINERAL WATER QUALITY CONSTITUENTS WITH SOIL MATERIALS IN RAPID INFILTRATION GROUNDWATER RECHARGE SYSTEMS USING RECLAIMED WASTEWATERS,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
S. V. Mattigod, and P. F. Pratt.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84 154251, Price codes: A03 for paper copy, A01 for microfiche. California Water Resources Center Completion Report, Univ. of California, Davis, November, 1983. 12 p, 7 Tab, 8 Ref, 1 Append. Project No. OWRT A-079-CAL (3).

Descriptors: *Reclaimed water, *Wastewater, *Wastewater renovation, *Groundwater recharge, *Reclaimed water, *Heavy metals, Water quality, Infiltration, Percolation, Soil chemistry, Soil properties, Superstition sand, San Emigdio soil.

Solutions containing Ca, Mg, K, Na, Pb, Ni, Cd, Cr, Cu, Zn, NH4, SO4, Cl, HCO3, PO4 at concentrations that are typically encountered in wastewaters were allowed to percolate through soil columns 15 cms in diameter and 200 cm deep in two soils; San Emigdio and Superstition sands with known physical and chemical properties were used in these experiments. The analysis of the percolating waters indicated that the trace metal concentrations were attenuated to the extent of non-detectability by atomic absorption spectrometry. The San Emigdio soil showed greater attenuation of PO4 and NH4 in comparison with Superstition sand. Speciation calculations by using GEOCHEM indicated that the major fractions of the trace metals were in cationic form and therefore would be adsorbed by the soil exchange complex. Simulations that include the presence of dissolved organics indicated that a major fraction of Cu, Ni, and Zn were complexed by the organic ligands. The speciation of Cd and Pb on the other hand were mainly influenced by the inorganic ligands. (Snyder-California)
W84-03697

MITIGATING WATER SUPPLY PROBLEMS IN THE NIGERIAN BASEMENT COMPLEX: ROLE OF UNDERSTANDING THE GEOHYDROLOGICAL ENVIRONMENT,
Ife Univ. (Nigeria). Dept. of Geography.
For primary bibliographic entry see Field 2F.
W84-03770

NUMERICAL MODEL TO EVALUATE PROPOSED GROUND-WATER ALLOCATIONS IN SOUTHWEST KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
D. G. Jorgensen, H. F. Grubb, C. H. Baker, Jr., G. E. Hilmes, and E. D. Jenkins.
Available from the Ofss, USGS, Lakewood, CO 80225, Price: $5.75 in paper copy, $3.50 in microfiche. USGS Water-Resources Investigations Report 82-4095, 1982. 46 p, 14 Fig, 1 Tab, 8 Ref.

Descriptors: *Groundwater management, Computer model, *Water rights, *Kansas, Water allocation, Interactive programs.

A computer model was developed to assist the Southwest Kansas Groundwater Management District No. 3 in the evaluation of applications to appropriate ground water. The model calculated the drawdown due from a proposed well at all existing wells in the section of the proposed well and at all wells in the adjacent eight sections. The depletion expected in the 9-square-mile area due to all existing wells and the proposed well is computed and compared with allowable limits defined by the management district. An optional program permits the evaluation of allowable depletion for one or more townships. All options are designed to run interactively, thus allowing for immediate evaluation of proposed ground-water withdrawals. (USGS)
W84-03850

4C. Effects On Water Of Man's Non-Water Activities

POTENTIAL EFFECTS OF SURFACE COAL MINING ON THE HYDROLOGY OF THE SNIDER CREEK AREA, ROSEBUD AND ASHLAND COAL FIELDS, SOUTHEASTERN MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
M. R. Cannon.
Available from the Ofss, USGS, Box 25425, Fed. Ctr. Denver, CO 80225; Price: $4.00 paper copy, $3.50 microfiche. USGS Water-Resources Investigations Report 82-4051, February, 1983. 28 p, 3 Tab, 23 Ref.

Descriptors: *Coal mines, Hydrology, Groundwater, Wells, Data collection, Rosebud coal field, *Montana, *Mining impacts, Snider Creek, Ashland coal field.

The Snider Creek area of the Rosebud and Ashland coal fields contains strippable reserves of Federal coal that have been identified for potential lease sale. A hydrologic study has been conducted in the potential lease area to describe the existing hydrologic systems and to assess potential impacts of surface coal mining on local water resources. Hydrogeologic data collected from stock wells, observation wells, and drill holes indicate that shallow aquifers exist within the Tullock, Lebo Shale, and tongue River Members of the Fort Union Formation (Paleocene age) and within valley alluvium (Pleistocene and Holocene age). Most of the wells in the area are completed in the basal part of the Tongue River Member or in the upper part of the Lebo Shale Member and are used for watering of livestock. Small stock reservoirs are the primary source of surface water; Snider Creek and all other streams that originate in the area are ephemeral. The Terrett coal bed, the primary coal bed of the area, is located above the water table. Mining of the Terrett coal bed would destroy one stock well and several small reservoirs. Four other wells near the coal outcrop might be destroyed by mining. Alternative ground-water supplies are available to replace those lost by mining. Degradation of the quality of ground water, caused by the leaching of soluble salts from mine spoils, is not anticipated. (USGS)
W84-03562

WATER LEVELS IN NASSAU COUNTY SEWER DISTRICTS 2 AND 3, LONG ISLAND, NEW YORK, 1978-1979,
Geological Survey, Syosset, NY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-03563

MAN-INDUCED CHANNEL ADJUSTMENT IN TENNESSEE STREAMS,
Geological Survey, Nashville, TN. Water Resources Div.
C. H. Robbins, and A. Simon.
USGS Water-Resources Investigations Report 82-4098, 1983. 129 p, 71 Fig, 5 Tab, 38 Ref.

Descriptors: *Aggradation, *Alluvial rivers, *Degradation, *Specific gage, *Tennessee, Erosion, Stages, Flood plains, Bridges, Hydraulic design, Shear stress, Mathematical equations, Streams, Streambeds, Fluvial morphology, Slope adjustment, Knickpoint migration, Bed level lowering, *Channelization.

Channel modifications in Tennessee, particularly in the western part, have led to large-scale instabilities in the channelized rivers and may have contributed to several bridge failures. These modifications, together with land-use practices, led to downcutting, headward erosion, downstream aggradation, accelerated scour, and bank instabilities. Changes in gradient by channel straightening caused more severe channel response than did dredging or clearing. Large-scale changes continue to occur in all the channelized rivers: the Obion River, its forks, and the South Fork Forked Deer River. However, the non-channelized Hatchie River in west Tennessee not only withstood the natural stresses imposed by the wet years of 1973 to 1975 but continues to exhibit characteristics of stability. Water-surface slope, the primary dependent variable, proved to be a sensitive and descriptive parameter useful in determining channel adjustment. Adjustments to man-induced increases in channel-slope are described by inverse exponential functions of the basic form $S=ae(-b(t))$; where 'S' is some function describing channel-slope, 't' is the number of years since completion of channel work, and 'a' and 'b' are coefficients. Response times for the attainment of 'equilibrium' channel slopes are a function of the magnitude and extent of the imposed modifications. The adjusted profile gradients attained by the streams following channelization are similar to the predisturbed profile gradients, where no alteration to channel length was made. Where the channels were straightened by constructing cut-offs, thus shortening channel length, then slope adjustments (reduction) proceed past the predisturbed profile gradients, to new profiles with lower gradients. (USGS)
W84-03567

EFFECTS OF URBAN DEVELOPMENT ON THE AQUIFERS OF THE MEMPHIS AREA, TENNESSEE,
Geological Survey, Nashville, TN. Water Resources Div.
D. D. Graham.
USGS Water-Resources Investigations Report 82-4024, 1982. 20 p, 6 Fig, 3 Tab, 21 Ref.

Descriptors: *Tennessee, *Water supply, *Groundwater, *Aquifers, Land subsidence, Groundwater pollution, Landfills, Waste disposal, Groundwater movement, Potentiometric level, Memphis area, Withdrawal.

Ground-water withdrawals from aquifers in the Memphis area average about 190 Mgal/d. Potential problems associated with increases in pumpage and urban development are lowered water levels, contamination of the aquifers, and land subsidence. Long-term water-level declines in the Memphis Sand, the principal artesian aquifer of the area, range from less than 0.1 ft per year near the outcrop area to about 1.8 ft per year near the center of pumping. A 1980 map of the potentiometric map surface shows that small cones of depression around major pumping centers are superimposed on a regional cone. Except for increased pumping lift, few problems are expected from water level declines in the Memphis Sand. At present, there is very little pumpage from other aquifers in the area--the alluvium, the fluvial deposits and the Fort Pillow Sand--and no long-term water level declines are expected unless pumpage is increased significantly. Low concentrations of leachates from waste-disposal sites in the area have been detected in the water table aquifers near these sites, but no indication of contamination of the underlying artesian aquifers has yet been found. Seasonal land-surface elevation changes of less than 0.03 ft have been recorded by an extensometer near the center of the major cone of depression of the Memphis Sand. These changes correlate with seasonal changes in artesian pressure in the Memphis Sand. Over the period of record no significant net change in land-surface elevation has been recorded. (USGS)
W84-03586

PRELIMINARY APPRAISAL OF THE HYDROLOGY OF THE ROCK ISLAND AREA, LE FLORE COUNTY, OKLAHOMA,
Geological Survey, Oklahoma City, OK. Water Resources Div.
For primary bibliographic entry see Field 2F.
W84-03595

MAGNITUDE AND FREQUENCY OF FLOODS IN NEW JERSEY WITH EFFECTS OF URBANIZATION,
For primary bibliographic entry see Field 2E.
W84-03684

POTENTIAL EFFECTS OF SURFACE COAL MINING ON THE HYDROLOGY OF THE GREENLEAF-MILLER AREA, ASHLAND, COAL FIELD, SOUTHEASTERN MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
G. W. Levings.
Available from the Ofss, USGS, Lakewood, CO 80225, Price: $4.50 in paper copy, $3.50 in microfiche. USGS Water-Resources Investigations Report 82-4101, Feb. 1983. 31 p, 5 Fig, 5 Tab, 25 Ref.

Descriptors: Hydrology, Strip mines, *Water supply, *Groundwater, Powder River Basin, Ashland coal field, *Montana.

The Greenleaf-Miller area of the Ashland coal field contains reserves of Federal coal that have been identified for potential lease sale. A hydrologic study was conducted in the potential lease area in 1981 to describe the existing hydrologic system and to assess potential impacts of surface coal mining on local water resources. The hydrologic data collected from wells, test holes, and springs were used to identify aquifers in the alluvium (Pleistocene and Holocene age) and the Tongue River member of the Fort Union Formation (Paleocene age). Coal, clinker, and sandstone beds comprise the aquifers in the Tongue River Member. Most streams are ephemeral and flow only as a result of precipitation. The only perennial surface-water flow in the study area is along short reaches downstream from springs. A mine plan for the area is not available; thus, the location of mine cuts, direction and rate of the mine expansion, and duration of mining are unknown. The mining of the Sawyer and Knoblock coal beds in the Tonge River Member would effect ground-water flow in the area. Declines in the potentiometric surface would be caused by dewatering where the mine pits intersect the water table. Wells and springs would be removed in the mine area; however, deeper aquifers are available as replacement sources of water. The chemical quality of the ground water would change after moving through the spoils. The change would be an increase in the concentration of dissolved solids. (USGS)
W84-03853

EFFECTS OF AGRICULTURAL DRAINAGE ON UPLAND STREAMFLOW: CASE STUDIES IN MID-WALES,
Institute of Hydrology, Wallingford (England).
M. D. Newson, and M. Robinson.
Journal of Environmental Management, Vol. 17, No. 4, p 333-348, December, 1983. 7 Fig, 3 Tab, 18 Ref.

Descriptors: *Drainage, *Streamflow, *Land management, *Wales, Runoff, Flood control, Floods, Watercourses, Agricultural runoff, Agricultural hydrology.

Two small sites in mid-Wales were instrumented to investigate claims that the drainage of upland areas for agriculture can lead to an increased flood risk for areas downstream. Measurements at both sites indicated that the effect of the artificial drainage was to reduce the peak rates of outflow into the stream network. This reduction was achieved by a general lowering of the soil water table, providing both an increasc in the available moisture storage at times of rainfall and encouraging the movement of water in deeper, less permeable, horizons of the soil. The incidence of waterlogging of surface layers was approximately cut in half, preventing poaching (structural damage of the soil through compaction by stock). While it seems that drainage of farmland would tend to moderate the flood risk downstream, caution must be used in extrapolating these results to specific situations. For example, delaying runoff from areas whose peak flows normally occurred before the catchment peak would tend to build up the overall peak discharge. Farm drainage schemes often require prior improvement of the main watercourses to provide sufficient freeboard for the drain outfalls to discharge freely. Such channel works tend to increase flow velocities and peak discharges and so will tend to counter the effect of slower runoff into the channel

network. This factor may be expected to become increasingly important as larger catchments are considered. (Baker-IVI)
W84-03955

EFFECTS OF CLEARCUTTING AND SITE PREPARATION ON STORMFLOW VOLUMES OF STREAMS IN PINUS ELLIOTTII FLATWOODS FORESTS,
Southeastern Forest Experiment Station, Gainesville, FL.
B. F. Swindel, C. J. Lassiter, and H. Riekerk.
Forest Ecology and Management, Vol. 5, No. 4, p 245-253, April, 1983. 3 Fig, 2 Tab, 9 Ref.

Descriptors: *Storm runoff, *Forest management, *Clearcutting, *Pines, *Florida, Cutting management, Logging, Streamflow, Flood peak, Runoff, Windrowing.

Operational-sized watersheds in pine flatwoods of the Lower Coastal Plain in north Florida were isolated and continuously monitored for 3 1/2 years. Recording flumes assessed quantity of runoff water. After 1 year of calibration monitoring, two of the three watersheds were harvested, site-prepared, and planted under distinct harvest and regeneration practices. Minimum practices, imposed on one watershed, consisted of manual shortwood harvest of pinelands, roller drum chopping of harvest residues and residual understory, bedding, and planting. Maximum practices, imposed on another, consisted of tree-length logging of pinelands with heavy equipment, extraction of lightwood stumps, burning and windrowing of logging residue and residual understory, harrowing, bedding, and planting. Both silvicultural systems increased stormflow volumes; but the maximum practices increased stormflow volumes more. Stormflow volumes apparently increased immediately following tree harvests. The increase persisted through site preparation, planting, and subsequently for 1 1/2 years without further detectable change. Based on this and two previous studies on the hydrologic response of flatwoods forests to silviculture, some conclusions were drawn. Peakflow rate is considered to be a sensitive parameter that may be detectably altered by silviculture, including clearcutting. Windrowing appears to be the most influential practice in increasing peakflow rates. Total surface water yield response is quite distinct depending on the silvicultural system employed. Practices that denude and level the soil surface and stream banks may produce a persistent increase in water yield. (Moore-IVI)
W84-04125

PRESCRIBED BURNING OF PINUS OOCARPA IN HONDURAS; I. EFFECTS ON SURFACE RUNOFF AND SEDIMENT LOSS,
Escuela Nacional de Ciencias Forestals, Comayagua (Honduras).
J. Hudson, M. Kellman, K. Sanmugadas, and C. Alvarado.
Forest Ecology and Management, Vol. 5, No. 4, p 269-281, April, 1983. 3 Fig, 2 Tab, 14 Ref.

Descriptors: *Prescribed burning, *Runoff, *Soil erosion, *Pines, *Honduras, Slope, Vegetation, Grasses, Forbs.

The effects of low-intensity prescribed burning on surface runoff and sediment loss were studied in a stand of oocarpa pine (Pine oocarpa Schiefe) in central Honduras. The effects of burning in two seasons were compared on small paired plots on 10 degree, 25 degree and 40 degree slopes. Over a period of almost 2 years, mean percent runoff was 1.73% on the control plots and 5.03% on the burned plots. Mean sediment loss during the same period was 80 kg/ha on the control plots and 1732 kg/ha on the burned plots. The relationship between slope and surface runoff and sediment loss was negative; the effect of slope being masked by variation of other site factors. Recovery from burning was rapid and is attributed to the rapid rate of recovery of the ground vegetation of grasses and forbs which are adapted to frequent burning. Surface runoff and sediment loss on control plots were very low and the increases caused by burning are considered an acceptable alternative to the exposure of the overstory and site to the high risk of wildfires in accumulated fuels. Greater runoff and sediment loss were recorded on the plots buring in February than on those burned in June. As the period November to mid-February offers the greatest number of days with weather conditions suitable for low-intensity prescribed burning, it is concluded that burning for hazard reduction should be conducted as early as possible in this period, in November and December, to permit greater recovery of the ground vegetation before the heavy rains of May and early June. (Author's abstract)
W84-04126

REDUCED-RANK PREDICTION MODEL OF STREAM-CHANNEL SIZE RESPONSE TO TRADITIONAL AGRICULTURAL LAND-USE PRACTICES IN SOUTHWESTERN NIGERIA,
Benin Univ., Benin City (Nigeria). Dept. of Geography.
F. O. Odemerho.
Journal of Hydrology, Vol. 70, No. 1-4, p 85-100, 1984. 9 Tab, 28 Ref.

Descriptors: *Land use, *Channel morphology, *Channel size, *Nigeria, Channel erosion, Fallowing, Farming, Overland flow, Environmental effects.

Stream-channel morphologic responses are found to be related to different parameters measuring traditional agricultural land-use patterns and practices in 50 small headwater basins in southwest Nigeria. The problem of intercorrelations among these parameters made it initially difficult to establish their precise channel enlargement effects and to calibrate an impact prediction model. Through factor analysis of the 22 land-use and morphometric parameters, six factors identified as measures of traditional land-use practice, farm size, planting activities, shortened fallow, relief and overland flow, were found to account for 86% of the variance in the data. The factor-defining variables are length of cropping period, areas in short fallow, farm-plot size, length of farm preparation relief ratio and overland flow. In a multiple regression analysis, only the first three variables were found to be statistically significant in explaining stream-channel morphologic responses. Thus, areas in short fallows, average farm size and length of cropping period adequately described those aspects of the traditional farming practices that effect basin hydrologic and channel responses. Since these variables were orthogonally derived, they formed the basis for the evaluation of the channel impact status of traditional land-use activities. The duplication of information and effects in the original 22-variable full-rank model were removed while utilizing the three-factor reduced model. (Author's abstract)
W84-04144

4D. Watershed Protection

STRAW RESIDUE TO CONTROL FURROW EROSION ON SLOPING, IRRIGATED CROPLAND,
Agricultural Research Service, Kimberly, ID. Snake River Conservation Research Center.
R. D. Berg.
Journal of Soil and Water Conservation, Vol. 39, No. 1, p 58-60, January-February, 1984. 1 Fig, 4 Tab, 4 Ref.

Descriptors: *Erosion control, *Farm management, *Straw, *Idaho, *Irrigation, Crop yield, Sedimentation, Silt, Soil conservation.

Many fields in southern Idaho have a relatively flat slope at the upper end and a steep slope toward the middle or lower end of the field. During irrigation, flow velocity increases on the steeper sloping sections of furrows, and soil erosion increases greatly. Small amounts of straw placed uniformly in steeply sloping portions of irrigation furrows reduced soil erosion and sedimentation on three fields with an erodible silt loam soil. Erosion was eliminated during the first irrigation on two fields in the straw-treated plots and markedly reduced during subsequent irrigations on these plots and on the third field. The reduction ranged from 30 to 100% in straw-treated furrows compared to furrows without straw. Straw treatment also increased infiltration and lateral water movement significantly, and crop yields rose 7 to 16%. Placing straw in the furrows below the critical-slope areas resulted in the trapping of too much sediment. Furrows filled with sediment, resulting in inadequate irrigation of downslope portions of the field. (Baker-IVI)
W84-03867

SEDIMENTATION PROBLEMS IN RIVER BASINS,
Uppsala Univ. (Sweden). Naturgeografiska Inst.
For primary bibliographic entry see Field 2J.
W84-03970

WATERSHED RESPONSES TO CONSERVATION MEASURES,
Central Soil and Water Conservation Research and Training Inst., Dehra Dun (India).
G. Sastry, and V. V. D. Narayana.
Journal of Irrigation and Drainage Engineering, Vol. 110, No. 1, p 14-21, March, 1984. 3 Fig, 2 Tab, 6 Ref.

Descriptors: *Water conservation, *Watershed management, *Doon Valley, *India, Forest watersheds, Agricultural watersheds, Runoff, Soil conservation, Check dams, Soil loss, Land use, Grazing.

In Doon Valley, India, when a natural forest watershed open to grazing is deforested and cultivated, volume and peak rates of runoff were higher by 15% and 72%, respectively. When the agricultural watershed is treated with soil and water conservation measures (construction of small field levees or bunds), the peak rate and volume of runoff are reduced by 86% and 62%, respectively, of the corresponding values when it was a natural forest watershed and the corresponding reduction in soil loss was 94%. When another comparable natural forest watershed is provided with brushwood check dams at appropriate locations, although no appreciable reduction in peak rate of runoff was observed, soil loss was reduced by 54%. (Author's abstract)
W84-04090

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

WATER POLLUTION: A VIEW FROM ECOLOGY,
McGill Univ., Montreal (Quebec). Inst. of Oceanography.
G. Sabatini, and B. M. Marcotte.
Marine Pollution Bulletin, Vol. 14, No. 7, p 254-256, 1983. 1 Tab, 15 Ref.

Descriptors: *Bioassay, *Water pollution effects, Industrial wastes, Environmental effects, Pollutant identification, Trout, Diatoms, Marine bacteria.

The results of various methods typically used by governments to assess the environmental impact of potential pollutants do not give comparable results. It is argued that the cause is not the assessment techniques themselves, but rather the paradigm of ecology from which they spring. Three bioassays are examined: LC-50, EC-50, and CI-50. The potentially toxic pollutant tested with the three bioassays was a heavy metal effluent from a plating industry containing 1.5 ppm Cr and 26.3 ppm Ni. Bioassay species used included the trout Salmo gairdnerii, the marine diatom Thalassiosira pseudonana and the marine bacterium Photobacterium phosphoreum. Three entirely different results were obtained with the three different techniques used. (Baker-IVI)
W84-03537

ENUMERATION OF THE BACTERIAL CONTAMINATION OF BIVALVES IN MONITORING THE MARINE BACTERIAL POLLUTION,
Brest Univ., Quimper (France). Inst. Univ. de Technologie.
A. Plusquellec, M. Beucher, and Y. Legal.
Marine Pollution Bulletin, Vol. 14, No. 7, p 260-263, 1983. 3 Fig, 3 Tab, 13 Ref.

Descriptors: *Enumeration, *Bacteria, *Contamination, *Bivalves, *Marine pollution, Shellfish, Coliforms, Streptococci, Water pollution, Detection limits, Bacterial analysis, Bioindicators, Fate of pollutants.

Marine organisms such as shellfish are capable of filtering large amounts of sea water and of retaining pathogenic bacteria. This property constitutes a way for evaluating the level of bacteria contamination in sea water. The enumeration of bacterial contamination was based on current fecal indicators. The sensitivity of mussels to concentrate bacteria is important and can be useful for detecting low levels of contamination which would otherwise be poorly evaluated by a direct analysis of water. The concentration factor appears to be more important for streptococci than for coliforms. This result could be the consequence of a differential absorption or a selective trapping of the two kinds of bacteria by the bivalves according to the dimensions of the microorganisms. The comparison between the level of bacteria in mussels and in the surrounding water shows that the contamination of mussels partially reflects that of the water at the same time. Different results would perhaps have been found if the analysis had been based on shellfish meat after the intervalvar water had been withdrawn. Despite some limitations, the use of shellfish as concentrating material appears to improve the bacterial enumeration results both in accuracy and consistency. (Murphy-IVI)
W84-03539

PREDICTING THE BIOACCUMULATION OF ORGANIC COMPOUNDS IN MARINE ORGANISMS USING OCTANOL/WATER PARTITION COEFFICIENTS,
Southern California Coastal Water Research Project Authority, Long Beach.
R. W. Gossett, D. A. Brown, and D. R. Young.
Marine Pollution Bulletin, Vol. 14, No. 10, p 387-392, 1983. 3 Tab, 22 Ref. NOAA grant NA80RAD00040.

Descriptors: *Prediction, *Bioaccumulation, *Organic compounds, *Octanol/water partition coefficients, Sediments, Aquatic fauna, Wastewater disposal, Wastewater management, Wastewater composition.

With the establishment of EPA's Priority Pollutant list, a growing number of wastewaters are now being analyzed for approximately 120 organic compounds. With the increasing number of organic compounds being discharged and the relatively high cost of analysis, it seems prudent to devise a means of assigning priorities as to which of these compounds should be routinely mentioned. One such approach is the utilization of the organic solubility of a compound as a predictive tool for its bioaccumulation by exposed organisms (n-octanol/water partition coefficient). Sediments and animals collected from near the discharge zone of the Los Angeles County wastewater treatment plant were analyzed for 27 selected organic compounds that had been identified in the effluent. The sediment and tissue concentrations of these organic compounds were positively correlated with each other and with the n-octanol/water partition coefficient but these were negatively correlated with the effluent concentration. The n-octanol/water partition coefficients should be used to predict which organics have the potential to bioaccumulate and therefore cause biological effects. (Murphy-IVI)
W84-03541

DETERMINATION OF DISSOLVED ALUMINUM IN WATER SAMPLES,
Geological Survey, Reston, VA. Water Resources Div.
A. A. Afifi.
USGS Water-Resources Investigations Report 82-4018, 1983. 13 p, 5 Fig, 2 Tab.

Descriptors: Chelation, Spectrophotometric analysis, Dissolved aluminum, Moneric aluminum, Adsorption, *Pollutant identification, Methyl isobutyl ketone extract, Standard addition technique, *Aluminum, *Water analysis.

A technique has been modified for determination of a wide range of concentrations of dissolved aluminum (Al) in water and has been tested. In this technique, aluminum is complexed with 8-hydroxyquinoline at pH 8.3 to minimize interferences, then extracted with methyl isobutyl ketone (MIBK). The extract is analyzed colorimetrically at 395 nm. This technique is used to analyze two forms of monomeric Al, nonlabile (organic complexes) and labile (free, Al, Al sulfate, fluoride and hydroxide complexes). A detection limit 2 ug/L is possible with 25-ml samples and 10-ml extracts. The detection limit can be decreased by increasing the volume of the sample and (or) decreasing the volume of the methyl isobutyl ketone extract. The analytical uncertainty of this method is approximately + or - 5 percent. The standard addition technique provides a recovery test for this technique and ensures precision in samples of low Al concentrations. The average percentage recovery of the added Al plus the amount originally present was 99 percent. Data obtained from analyses of filtered standard solutions indicated that Al is adsorbed on various types of filters. However, the relationship between Al concentrations and adsorption remains linear. A test on standard solutions also indicated that Al is not adsorbed on nitric acid-washed polyethylene and polypropylene bottle wells. (USGS)
W84-03587

ANALYSES OF ELUTRIATES, NATIVE WATER, AND BOTTOM MATERIAL IN SELECTED RIVERS AND ESTUARIES IN WESTERN OREGON AND WASHINGTON,
Geological Survey, Portland, OR. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-03601

USE OF A MIXED ALGAL CULTURE TO CHARACTERIZE INDUSTRIAL WASTEWATERS,
Uppsala Univ. (Sweden). Inst. of Physiological Botany.
A. Claesson.
Ecotoxicology and Environmental Safety, Vol. 8, No. 1, p 80-96, February, 1984. 9 Fig, 4 Tab, 12 Ref.

Descriptors: *Algae, *Industrial wastewater, Polyvinylchloride, Textile mill wastes, Chemical wastes, Mine wastes, Pulp wastes, Oil wastes, Algal growth, Bioindicator, Water pollution effects.

There is a great need for the capability to predict the effects of complex wastewater effluents from industrial processes on the natural environment. To be able to increase the value of the predictions, specifically for the recipient, it is necessary to study the influence of an effluent on the living organisms. A mixture of five freshwater algae was cultivated with additions of wastewater samples from chemical, mining, polyvinylchloride, textile, paper mill, and oil refinery industries. Two water samples from chemical industries and one from an oil refinery stimulated the algal growth in a nutrient-poor medium, while growth in other samples, including a nutrient-rich medium, was inhibited in several different ways. For eight of the water samples a delayed growth of 2-4 days was noted. Decreased growth rate and lowered maximal biomass occurred in seven of the samples. The photosynthetic capacity of the algal cells was measured by using in vivo fluorescence of chlorophyll a. These quick measurements mostly agreed with those of the growth rates. When the species composition of the mixed algal culture was investigated, large differences in sensitivities between the different species were found. Stimulation or inhibition were observed in the same sample for different species but also for the same species at different concentrations. To use a mixed algal culture is one attempt to increase the value of prognosis for the fate of substances, products, or industrial wastewaters when discharged into recipients. By exposing algae to constant concentrations of a test sample (flow-through experiments), and by keeping the environmental conditions as equal as possible to the actual effluent situation, more accurate predictions for the recipient situation should be possible. (Murphy-IVI)
W84-03705

RAPID-CELL CULTURE ASSAY OF WATER QUALITY,
Oklahoma State Univ., Stillwater. School of Biological Sciences.
S. R. VanDoren, M. S. Hall, L. B. Frazier, and F. R. Leach.
Bulletin of Environmental Contamination and Toxicology, Vol. 32, No. 2, p 220-226, February, 1984. 1 Fig, 1 Tab, 7 Ref.

Descriptors: *Cultures, *Water quality, *Bioassay, HeLa cells, Monitoring, Toxicity, Thymidine, Pollutants.

A cell culture screen was developed to determine water quality of environmental samples. The assay uses HeLa cells growing on microcarrier beads and a 4 hr thymidine incorporation as a screen for water toxicity. Advantages of the system are: the use of a small volume of water in the test; the ability to do the test and have the final result within a 24 hr period; the use of a large number of cells which eliminates the complications produced by using a few organisms in a bioassay; and the capability of using other biosysnthetic processes to assess toxicity. The use of the assay is demonstrated with two types of environmental samples, one a typical oil refinery effluent and the other a sample of water from the Tar Creek area of Oklahoma which serves as the principal drainage system of the Picher field, one of the most productive lead-zinc mining districts in the United States. (Baker-IVI)
W84-03708

USE OF FISH GILL AND LIVER TISSUE TO MONITOR ZINC POLLUTION,
Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.
J. G. Saltes, and G. C. Bailey.
Bulletin of Environmental Contamination and Toxicology, Vol. 32, No. 2, p 233-237, February, 1984. 1 Fig, 1 Tab, 21 Ref.

Descriptors: *Zinc, *Trout, *Water quality, *Monitoring, Spokane River, Washington, Biological magnification, Fish.

Zinc bioconcentration in 13 rainbow trout and 5 brook trout was determined to understand whether zinc concentrations in gill and liver tissue of the wild salmonids had decreased with the decline in ambient concentrations. The mean and range of zinc concentration in gill and liver tissues of the 1980-81 fish was 1000 (382-1634) and 395 (155-749) micrograms/g, respectively. The mean bioconcentration factors were 9708X for gill and 3835X for liver tissue. It was expected that the zinc concentration of liver tissue of Spokane River fish would reflect the lower ambient concentrations. The fact that this did not occur suggests that there are other unknown factors which account for this discrepancy in tissue concentrations of zinc and zinc exposure for the Spokane River fish. The use of fish tissue as an indicator of metal concentration in an aquatic system may not be appropriate for a metal such as zinc which is homeostatically controlled. Investigators are urged to refrain from using fish as biomonitors of metal pollution until fish response to metal stress can be properly interpreted. (Baker-IVI)
W84-03710

IRON AND HYDROGEN SULFIDE INTERFERENCE IN THE ANALYSIS OF SOLUBLE

REACTIVE PHOSPHORUS IN ANOXIC WATERS,
McGill Univ., Montreal (Quebec). Dept. of Biology.
G. Nurnberg.
Water Research, Vol. 18, No. 3, p 369-377, 1984. 9 Fig, 4 Tab, 40 Ref.

Descriptors: *Water analysis, *Phosphorus, Hydrogen sulfide, Water quality control, Hypolimnion, Chemical analysis, Anoxic water, Iron, Calcium.

Anoxic water from eight lakes containing various amounts of ferrous iron, hydrogen sulfide, calcium and total phosphorus was analyzed for soluble reactive phosphorus (SRP). Hydrogen sulfide concentrations higher than 1 mg/l and ferrous iron concentration above 0.20 mg/l produced interferences in the SRP analysis on many occasions. Interfering concentrations of these materials are present in anoxic water from a large number of lakes, groundwater springs and ocean basins. Ferrous iron is not problematic to the analysis if the sample is kept anoxic before and during filtration. Vigorous aeration is obligatory if hydrogen sulfide is present. For water from the anoxic hypolimnia of the eight lakes a modified analysis of total (unfiltered) reactive phosphorus (TRP) yields on average only 2% lower phosphorus concentrations than SRP analysis. TRP hence can replace the complicated SRP in anoxic water analysis. (Baker-IVI)
W84-03740

GROWTH RESPONSE IN FISH CHRONIC AND EARLY LIFE STAGE TOXICITY TESTS: A CRITICAL REVIEW,
Procter and Gamble Co., Cincinnati, OH. Environmental Safety Dept.
D. M. Woltering.
Aquatic Toxicology, Vol. 5, No. 1, p 1-21, February, 1984. 1 Fig, 4 Tab, 120 Ref.

Descriptors: *Toxicity, *Testing procedures, *Water pollution effects, *Fish, Metals, Pesticides, Organic compounds, Detergents, Inorganic compounds, Effluents, Growth stages.

The utility of the standard fish chronic toxicity endpoints to chemical hazards evaluations was examined through analysis of toxicity data from 25 years of fish life cycle chronic, partial chronic and early life stage tests. Particular emphasis was placed on the growth response. The 173 tests evaluated included exposure to metals, pesticides, unclassified organics, inorganic compounds, detergents and complex effluents. Survival of fry was significantly reduced in 57% of all tests at the lowest effect concentration. Growth of fry was reduced in 36% and egg hatching in 19% of tests. Fry survival and growth were very often correlated as equally sensitive, but fry growth was the single most sensitive response in only 14% of the tests. As presently used, the growth response could be deleted from routine applications of the fish early life stage test. The net result would be a significant reduction in the duration and cost of screening tests with no appreciable impact on estimating the maximum acceptable toxicant concentration (MATC) for chemical hazard assessments. Whether or not to include growth (or reproduction) as a routine endpoint in fish chronic toxicity tests is ultimately a question of what additional sensitivity or information is gained or could be with some modification, and how the time and money should be spent to screen new and expanded-use chemicals and effluents. The available data base suggests that the additional time and expense of the standard growth response in fish early life stage tests are unwarranted for routine chemical hazard assessments. (Baker-IVI)
W84-03741

BEHAVIOURAL BIOASSAY FOR IMPAIRED SEA-WATER QUALITY USING THE PLANTIGRADES OF THE COMMON MUSSEL MYTILUS EDULUS L.: THE RESPONSE TO COPPER,
Sheffield Univ. (England). Dept. of Zoology.
N. M. H. Sheffrin, N. R. J. Fieller, and E. E. Williams.
Aquatic Toxicology, Vol. 5, No. 1, p 77-91, 1984. 6 Fig, 5 Tab, 37 Ref.

Descriptors: *Bioassay, *Copper, *Mussels, *Behavior, Effects of pollutants, Plantigrades, Mytilus, Seawater.

A bioassay is presented which is based upon the ecologically significant behavioral responses of crawling and byssal attachment of the plantigrades of the common mussel for copper-impaired sea water. Potentiometric stripping analysis has been used to quantify the total and electrochemically labile species of copper. The threshold of sensitivity for the bioresponse lies between 13 ppb total, 8 ppb labile and 25 ppb total, 15 ppb labile copper, for a bioassay of 1 hr duration. There is an example of hormesis for the bioresponse of the number of plantigrades that crawl for levels of copper at and below 13 ppb total, 8 ppb labile metal. The effects of light and gravity as directional cues and the effect of animal size and density in the bioassay have also been considered. The test organism is available for most of the year and is economically and ecologically important. Individuals are of similar age/size and from the same area. The bioassay is easy to learn, cheap to run, short in duration and meets the normal statistical requirements. (Baker-IVI)
W84-03743

AUSTRALIAN FRESHWATER MUSSEL VELESUNIO AMBIGUUS (PHILIPPI) AS A BIOLOGICAL MONITOR FOR ZINC, IRON AND MANGANESE,
Adelaide Univ. (Australia). Dept. of Zoology.
P. J. Millington, and K. F. Walker.
Australian Journal of Marine and Freshwater Research, Vol. 34, No. 6, p 873-892, 1983. 10 Fig, 7 Tab, 38 Ref.

Descriptors: *Pollutant identification, *Bioindicators, *Mussels, Zinc, Iron, Manganese, Heavy metals, Velesunio, Australia, River Murray.

The possible use of the hybrid mussel V. ambiguus as a biological monitor of zinc was explored in the River Murray. A high variation in zinc content was found among individuals and between populations. Part of the variation was systematic, associated with body weight and age. However, a larger part remained statistically unexplained. Further, while V. ambiguus readily accumulated zinc, depuration was slow. At zinc concentrations of 210 mg/l and above, mussels avoided taking up zinc by significantly curtailing siphoning, movement and valve opening. At zinc levels above 20 mg/l, lethal level, most deaths occurred in the post-exposure periods immediately after 96-, 176- and 336-hr toxicity tests. The estimated 336 hr LC50 was 66 mg/l with 95% confidence limits 55 and 77 mg/l. Exposure of caged mussels in the zinc-contaminated Molonglo River, New South Wales suggests that V. ambiguus is not suitable as a species to monitor variations in zinc loads between sites, and does not accurately reflect environmental fluctuations of zinc, iron, or manganese, although it may have potential for materials other than heavy metals. (Baker-IVI)
W84-03750

MOLECULAR PHOTOLUMINESCENCE SPECTROMETRY WITH HYDRIDE GENERATION FOR DETERMINATION OF TRACE AMOUNTS OF ANTIMONY AND ARSENIC,
National Research Inst. for Pollution and Resources, Kawaguchi (Japan).
H. Tao, A. Miyazaki, K. Bansho, and Y. Umezaki.
Analytical Chemistry, Vol. 56, No. 2, p 181-185, February, 1984. 6 Fig, 3 Tab, 20 Ref.

Descriptors: *Pollutant identification, *Antimony, *Arsenic, *Spectrometry, Molecular photoluminescence spectrometry, Hydrides, Heavy metals.

Molecular photoluminescence spectrometry is a very sensitive and selective method for the determination of some hydrides and has been used for the determination of antimony and arsenic. Both elements were generated as hydrides and irradiated with ultraviolet light. The broad continuous emission bands were observed in the ranges about 240-750 nm and 220-720 nm, and the detection limits were 0.6 ng and 9.0 ng for Sb and As, respectively. Some characteristics of the photoluminescence phenomenon were made clear from spectroscopic observations. After the interference study, the method was successfully applied to the determination of antimony in river water and seawater. The advantages of this method include wide dynamic range and good selectivity plus a low and stable background level. (Baker-IVI)
W84-03752

DETERMINATION OF TRACE ANIONS IN WATER BY MULTIDIMENSIONAL ION CHROMATOGRAPHY,
Environmental Research Lab., Athens, GA.
T. B. Hoover, and G. D. Yager.
Analytical Chemistry, Vol. 56, No. 2, p 221-225, February, 1984. 6 Fig, 3 Tab, 18 Ref.

Descriptors: *Pollutant identification, *Water analysis, *Ion chromatography, Selenium, Arsenic, Selenates, Senenites, Arsenates, Chlorides, Nitrates, Sulfates, Drinking water, Water quality control, Chromatography.

Selenate, selenite, and arsenate ions were separated from the major anions chloride, nitrate, and sulfate in drinking water, surface water, and groundwater souces by collecting a selected portion of the ion chromatograph, after suppression, on a concentrator column and reinjecting at the original chromatographic conditions. Statistical detection limits varied from 0.02 to 1.2 micrograms of trace element depending on the minor components to be separated and on the water matrix but independent of initial sample size from 2 to 10 ml. The maximum reliably separated molar ratio was 1300 for sulfate/selenate in well water. Carbonate-bicarbonate eluent compositions were optimized for each trace ion. The technique is not applicable to anions of weak electrolytes that are not retained by the concentrator, e.g., fluoride, cyanide, or arsenite. (Baker-IVI)
W84-03753

DETERMINATION OF LOW LEVELS OF BROMIDE IN FRESH WATER AFTER CHROMATOGRAPHIC ENRICHMENT,
Uppsala Univ. (Sweden). Dept. of Analytical Chemistry.
U. Lundstrom, A. Olin, and F. Nydahl.
Talanta, Vol. 31, No. 1, p 45-48, January, 1984. 5 Tab, 8 Ref.

Descriptors: *Bromide, *Fresh water, *Chromatographic enrichment, Sodium perchlorate, Chloride, Sweden.

A method has been developed for the determination of bromide in fresh water. The analyte is enriched on the anion-exchanger Dowex 1 x 8, which exhibits a considerably greater affinity for bromide than for the major anions in fresh water. Sodium perchlorate is used as eluent and an enrichment factor of about 100 can be achieved. The eluted bromide is oxidized with peroxodisulfate to bromate, which is determined iodometrically by a previously published spectrophotometric method. The enrichment in the presence of the major components of fresh water has been studied. Only bicarbonate has been found to interfere, but this interference can be avoided by acidifying the sample with hydrochloric acid. The recovery from synthetic fresh water with ionic concentrations corresponding to 0.005 equivalent/l and spiked with bromide was 100% at bromide concentrations larger than 50 n M (4 microg/l) and about 90% at 10 nM. The detection limit is 1.5 nM and the limit of determination 5 nM for 1-liter samples. (Author's abstract)
W84-03802

DIATOMS AS INDICATORS OF THE RATE OF LAKE ACIDIFICATION,

Brock Univ., St. Catharines (Ontario). Dept. of Biological Sciences.
M. Dickman, S. Dixit, J. Fortescue, B. Barlow, and J. Terasmae.
Water, Air, and Soil Pollution, Vol. 21, No. 1-4, p 375-386, January, 1984. 7 Fig, 1 Tab, 21 Ref.

Descriptors: *Diatoms, *Bioindicators, *Lake acidification, Hydrogen ion concentration, Sediments, Water pollution effects, Acid rain, History, Lakes, Acid water.

Autecological studies of diatoms as pH indicators have opened the way to estimating a lake's past pH on the basis of its diatom species composition and relative abundance. Estimating the rate of lake acidification from its sediment subfossil diatoms is possible when these subfossils can be identified and accurately enumerated in the surface sediments of 20 to 30 lakes. Once this is done the diatoms down the length of the sediment core of one or more of these lakes can be enumerated and the pH inferred at each depth. This technique holds considerable promise in assessing the temporal impact of acid precipitation for acid-sensitive lakes. When log values were regressed against observed pH for 28 lakes located north of Lake Superior, a significant ($P < 0.01$) correlation ($r = 0.89$) resulted. Down-core diatom stratigraphy for one of these lakes indicated that its pH had dropped from 6.2 to 5.2 over the last 2 yr while a second lake had dropped from a pH of 7.1 to 5.2 over the last 30 yr. The diatom inferred pH technique, when carefully calibratd in the study area in which it is used has proved to be a valuable tool in estimating the rate of lake acidification. (Murphy-IVI)
W84-03839

IDENTIFICATION OF CHLORINATED NITROBENZENE RESIDUES IN MISSISSIPPI RIVER FISH,
Food and Drug Administration, Washington, DC. Div. of Chemical Technology.
M. P. Yurawecz, and B. J. Puma.
Journal Association of Official Analytical Chemists, Vol. 66, No. 6, p 1345-1352, November, 1983. 2 Fig, 3 Tab, 10 Ref.

Descriptors: *Chlorinated nitrobenzene, *Mississippi River, *Fish, Industrial wastes, Bioindicators, Pesticides, Organochlorine, Organophosphorus,.

FDA monitoring programs for pesticide and industrial chemical residues in foods have included analyses of selected food samples, mainly of domestic fresh-water fish, for residues of electron-capturing industrial chemicals. These residues are recovered in the 6% ethyl ethel-petroleum ether eluate of the Florisil cleanup procedure, but are too volatile for electron capture gas chromatography analysis at the operating conditions recommended. Residues of lower chlorinated nitrobenzenes have been found at levels up to about 1 ppm in 8 samples of Mississippi River fish. Electron capture gas chromatography (EC/GC) was used for determination after extraction and cleanup using a procedure based on the AOAC multiresidue method for organochlorine and organophosphorus pesticides in nonfatty foods. The residues found included 2-, 3-, and 4-chloronitrobenzene and 2,3- and 3,4-dichloronitrobenzene, identify was confirmed by GC/mass spectrometry. GC retention times for 15 monochloro-through pentachloro-substituted nitrobenzene congeners were determined with OV-101 and mixed OV-101 + OV-210 columns at 130 degrees C. In studies of the nonfatty food extraction and cleanup procedures of the AOAC method, recoveries of 15 chlorinated nitrobenzenes from spiked fish samples ranged from 68 to 116%. GC of cleaned up fish extract aliquots equivalent to 20 mg sample allowed quantitation of individual congeners at levels of about 0.025 and 0.005 ppm with H-3 and Ni-63 EC detectors, respectively. The contamination of Mississippi River fish with chlorinated nitrobenzenes appears to be localized in a 150 mile section of the river extending from St. Louis, MO, to Cape Girardeau, MO; no chlorinated nitrobenzenes (< 0.005 ppm) were detected in Mississippi River fish caught above or below this region of the river or in fish from the lower Missouri River, which joins the Mississippi River near St. Louis. (Murphy-IVI)
W84-03866

DETERMINATION OF SULPHATE IN NATURAL WATER BY FLOW-INJECTION ANALYSIS,
Okayama Univ., Kurashiki (Japan). Inst. for Agricultural and Biological Sciences.
S. Nakashima, M. Yagi, M. Zenki, M. Doi, and K. Toei.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 317, No. 1, p 29-31, 1984. 3 Fig, 1 Tab, 4 Ref.

Descriptors: *Sulfate, *Natural waters, *Flow-injection analysis, Cations, Ions, Japan.

Sulfate was determined in natural water samples by flow-injection analysis using dimethylsulfonazo-III as reagent. The interference by Ca was eliminated by a cation-exchanger column inserted directly after the sample injection valve. In order to ensure high sensitivity and reproducibility it was necessary to saturate the carrier solution with barium sulfate and to fill the reaction coil with ethanol-water (1:1) when not in use. Standard deviations were 0.94-1.2% for 6-10 mg/l sulfate. The limit of detection was about 0.2 mg/l. The calibration graph was linear up to 14 mg/l. Mg(2+), NH4(+), Na(+), K(+), Cl(-), NO3(-), PO4(3-), HCO3(-) and SiO3(2-) did not interfere in the normally occurring concentrations. (Author's abstract)
W84-03898

TRIBUTYLTIN DETECTION AT TRACE LEVELS IN WATER AND SEDIMENTS USING GC WITH FLAME-PHOTOMETRIC DETECTION AND GC-MS,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
M. D. Mueller.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 317, No. 1, p 32-36, 1984. 3 Fig, 2 Tab, 13 Ref.

Descriptors: *Tributyltin, *Trace levels, Sediments, Water analysis, Gas chromatography.

A sensitive and specific method for the determination of low levels of tributyltin (TBT) in water and sediments is presented. The procedure is based on the conversion of tributyltin compounds to tributylmethyltin (TBMeT) and analysis using GC with flame photometric detection (GC-FPD) and GC-MS. Detection limits of less than 1 ppt for water and 0.5 ppb for sediment are achieved. River and lake water and lake sediments analyzed show tributyltin to be present in the low ppt- and ppb-range, respectively. (Author's abstract)
W84-03899

SPECTROPHOTOMETRIC DETERMINATION OF NITRITE PRODUCED BY FLOW-ELECTROLYSIS OF NITRATE,
Fukui Univ. (Japan). Dept. of Chemistry.
R. Nakata.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 317, No. 2, p 115-117, 1984. 6 Fig, 1 Tab, 12 Ref. Japanese Ministry of Education, Science and Culture grant 57740288.

Descriptors: *Spectrophotometry, *Nitrite, Electrolysis, Ions, Natural waters, nitrate, Copper, Cadmium.

The electrocatalytic reduction of nitrate to nitrite with a carbon column electrode in the presence of Cu(2+) and Cd(2+) was investigated in a flow system. Electrogenerated nitrite was mixed with color-producing reagents and detected colorimetrically. In acetate and phosphate buffer solutions, the reduction of nitrate to nitrite or further reduction of nitrite was monitored by scanning the electrode potential. In phosphate buffer solutions, the yield of nitrite went up to a maximum in the presence of Cu(2+) and Cd(2+) at above -1.1 V. The electrocatalytic reduction method was applied to the determination of nitrate in river water instead of the conventional Cu-coated Cd column. (Author's abstract)
W84-03900

ION CHROMATOGRAPHY IN PRECIPITATION (IONEN-CHROMATOGRAPHIE IN NIEDERSCHLAGSWASSER),
Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Chemie.
K. P. Muller.
Fresenius Zeitschrift fur Analytische Chemie, No. 3-4, p 345-346, 1984. 3 Ref.

Descriptors: *Ion chromatography, *Rain water, Ions, Chromatography, Chemistry of precipitation, Anions, Cations.

Ion chromatography can successfully detect a number of anions and some cations from rain water. Improved separation efficiency and sensitivity was achieved by special column configuration and temperature stabilization. The following anions can be detected simultaneously: F(-), Cl(-), NO2(-), NO3(-), PO4(3-), Br(-), SO4(2-), HCOO(-), CH3COO(-). (Murphy-IVI)
W84-03901

INDIRECT TRACE DETERMINATION OF NTA IN NATURAL WATERS BY DIFFERENT PULSE ANODIC STRIPPING VOLTAMMETRY,
Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Angewandte Physikalische Chemie.
A. Voulgaropoulos, P. Valenta, and H. W. Nurnberg.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 317, No. 3-4, p 367-371, 1984. 2 Fig, 4 Tab, 16 Ref.

Descriptors: *Nitrilotriacetic acid, *Natural waters, Measuring instruments, Voltammetry, Bismuth, Cadmium, Copper, Lead, Zinc, Iron.

Nitrilotriacetic acid (NTA) appears to be the most suitable substitute for sodium tripolyphosphate to prevent the eutrophication of natural waters. Bismuth(III) is added in excess in the water sample to NTA and EDTA to form inert stable complexes at pH 2. The uncomplexed Bi(III) is then deposited into a hanging mercury drop electrode at a potential of -0.15 V vs. SCE and subsequently stripped anodically in the differential pulse mode. The peak current of uncomplexed Bi(III) is recorded. By a second deposition at -0.35 V vs. SCE Bi(III) from Bi(3+) and Bi-NTA is deposited. The concentrations of NTA and EDTA in the sample are determined from the concentration of added Bi(III) and the voltammetrically determined Bi(III) at these two potentials by the standard addition method. Cd, Cu, Pb, and Zn do not interfere. Fe(III) has to be reduced by ascorbic acid or hydroxylamine before the determination. Cu(II) in concentrations larger than 40 microg/l has to be removed by preelectrolysis. In samples with chloride contents above 0.05 M the stripping step has to be performed after medium exchange to a perchloric acid solution of pH 2. For a deposition time of 2 min the determination limit is approximately 0.2 microg/l NTA and 0.1 microg/l EDTA. The relative standard deviation for NTA concentrations at 2 or 10 microg/l lies at 10 or 1.3%, respectively. Good accuracy is established by finding within 2% the levels adjusted when water samples are spiked with a standard solutions of NTA or EDTA. (Murphy-IVI)
W84-03904

FRESHWATER MOLLUSCS AS ACCUMULATION INDICATORS FOR MONITORING HEAVY METAL POLLUTION,
Universitaet des Saarlandes, Saarbruecken (Germany, F.R.). Lehrstuhl fuer Biogeographie.
L. Zadory.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 317, No. 3-4, p 375-379, 1984. 6 Fig, 2 Tab.

Descriptors: *Mollusks, *Bioindicators, *Heavy metals, Water pollution, Behavior, Synergistic effects, Cadmium, Lead, Zinc, Saar River, Federal Republic of Germany.

For monitoring heavy metal pollution of streams in urban and industrial areas residue analyses were undertaken in different aquatic invertebrates with

special regard to the freshwater mollusks Bithynia tentaculata, Physa acuta, Radix peregra and Dreissena polymorpha to define the heavy metal residues in shell and soft body parts in natural populations. To control the distribution and dynamics of the heavy metals, the accumulation and elimination behavior is determined after experimental contamination tests with cadmium, lead and zinc and their complexes for synergisms on standardized populations under laboratory conditions. Due to a strong accumulation of these organisms they appear to be well suited for monitoring programs. Experimental studies show, that zinc and lead absorbed with the food accumulate in the hemolymph, the food muscle and the protein gland. The different rates of accumulation depend however among others on the different physiological variables as well as on population specific strategies. Furthermore, different mechanisms result in a rivalry among the heavy metals for uptake. (Author's abstract)
W84-03905

NITRATE IN DRINKING WATER OF WINE-GROWING AREAS - AN ION-CHROMATOGRAPHIC STUDY (NITRAT IM TRINKWASSER VON WEINBAUGEBIETEN - EINE IONEN-CHROMATOGRAPHISCHE STUDIE),
Goettingen Univ. (Germany, F.R.). Inst. fuer Anorganische Chemie.
T. Darimont, G. Schulze, and M. Sonneborn.
Fresenius Zeischrift fur Analytische Chemie, Vol. 317, No. 3-4, p 400-406, 1984. 7 Fig, 2 Tab, 51 Ref.

Descriptors: *Nitrate, *Drinking water, Ion chromatography, Farm wastes, Fertilizers, Wine orchards, Water pollution, Oberrhein, Main, Neckar, Federal Republic of Germany.

Wine-growing uses extremely high doses of nitrogenous fertilizer which can influence the quality of drinking water when washed out. To quantify the problem of burdening, drinking water was sampled from taps at 254 sites covering the wine-growing areas of Oberrhein, Main and Neckar. These samples were examined for their content of nitrate by means of ion-chromatography. 13% of the samples exceed the maximal concentration admissible and 42% are above guide levels. For the regions of Wurzburg, Wurttembergisch Unterland and Kaiserstuhl-Tuniberg-Markgraflerland which are particularly loaded with nitrate it can be proved that artificial fertilizers do indeed influence the quality of drinking water. In these cases a dependence of nitrate concentration in drinking water on the local situation of the water catchment places - in view of areas used for wine-production is given. A nitrate register for drinking water was established; it shows that parts of the population, who are particularly concerned, are additionally nitrate-burdened through drinking water by a factor of approximately four in comparison with other foods. A critical examination of purely immission-covering possibilities for the reduction of nitrate burdening leads to the necessity of regulations for limiting the emissions. (Murphy-IVI)
W84-03906

COMPARISON OF CONTINUOUS-FLOW (CFA) AND FLOW-INJECTION (FIA) TECHNIQUES FOR THE PHOTOMETRIC DETERMINATION OF TRACES OF ALUMINIUM IN WATER AND SOIL SAMPLES (VERGLEICH VON CONTINUOUS-FLOW-UND FLOW-INJECTION-ANALYSENTECHNIKEN ZUR PHOTOMETRISCHEN BESTIMMUNG VON ALUMINIUMSPUREN IN WASSERN UND BODEN),
Goettingen Univ. (Germany, F.R.). Inst. fuer Anorganische Chemie.
D. Zoltzer, and G. Schwedt.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 317, No. 3-4, p 422-426, 1984. 9 Fig, 3 Tab, 2 Ref.

Descriptors: *Continuous flow, *Flow injection, Comparison studies, Aluminum, Water analysis, Soil analysis.

The determination of aluminum is carried out by means of Chromazurol S. Interferences by iron(III) are eliminated by reduction with ascorbic acid. FIA shows more symmetric signals than CFA. By FIA also higher sample frequencies and better reproducibility are obtainable. Only Teflon tubes should be used for the analytical systems because of the adsorption of Al on glass surfaces. Detection limits are about 10 ng/ml of Al. In case of soil solutions and water samples the evaluation has to be performed according to the standard addition method as considerable matrix effects are caused by the organic substances. Only kinetically labile aluminum is determinable. Therefore, comparisons with atomic absorption determinations are presented. Correlations between pH-values of the soil solutions and the part of photometrically determinable aluminum are recognizable. (Author's abstract)
W84-03907

CHLOROPHYLL A TROPHIC STATUS CLASSIFICATION SYSTEM FOR SOUTH AFRICAN IMPOUNDMENTS,
Rhodes Univ., Grahamstown (South Africa). Dept. of Plant Sciences.
R. D. Walmsley.
Journal of Environmental Quality, Vol. 13, No. 1, p 97-104, 1984. 5 Fig, 3 Tab, 30 Ref.

Descriptors: *Chlorophyll a, *Trophic level, *Lake classification, *Reservoirs, Eutrophication, Water management, Algal blooms, Bioindicator, South Africa.

The use of chlorophyll a as an index of trophic status is based on the fact that it is normally the most abundant and important pigment in phytopankton cells; thus, measurements provide a convenient estimate of the phytoplankton biomass in a water body. Chlorophyll a data from 24 South African impoundments were examined with the objective of developing a trophic status classification system. For the combined data set, standard deviation of the mean annual chlorophyll a concentration displayed an almost 1:1 linear relationship to the mean, indicating a wide annual variation in chlorophyll a for most impoundments. There appeared to be no common seasonal pattern to the occurrence of chlorophyll a maxima and minima, leading to the conclusion that trophic status was best described by a statistical parameter based on annual data (notably the mean value). Statistically significant empirical formulae that relate both the maximum value and the frequency of occurrence of specific chlorophyll a ranges to the mean annual value were established, and their potential use in the assessment of trophic status and impoundment management is described. (Murphy-IVI)
W84-03940

APPLICATION OF SOME BENTHIC INDICES FOR QUALITY EVALUATION OF WATER HIGHLY POLLUTED WITH MUNICIPAL SEWAGE,
Polish Academy of Sciences, Warsaw. Dept. of Ecological Bioenergetics.
M. Kaniewska-Prus, and A. Kidawa.
Polskie Archiwum Hydrobiologii, Vol. 30, No. 3, p 263-269, 1983. 1 Fig, 2 Tab, 21 Ref.

Descriptors: *Water pollution, *Pollutant identification, *Municipal wastes, *Vistula River, *Warsaw, *Poland, Benthic environment, Chemical analysis, Wastewater pollution.

Several commonly used benthic indices describing the degree of water pollution were calculated for four sites of polysaprobic section of the Vistula River below Warsaw, Poland. No significant differences were found in values of these indices between sites. All indices for the four sites showed typical values for highly polluted waters. The lack of change along the 25 km stretch between the first and last site indicate that self purification is not occurring to any significant degree. No significant correlations were found between values of these factors and the chemical properties of the water. The average Chandler's score turned out to be the best for evaluating waters strongly polluted with municipal sewage. It was the least sensitive to water level changes in the river and to seasonal changes in macrobenthos numbers. (Baker-IVI)
W84-03990

ORGANIC CONTAMINANTS IN THE AQUATIC ENVIRONMENT; IV. ANALYTICAL TECHNIQUES,
Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
A. E. McIntyre, and J. N. Lester.
The Science of the Total Environment, Vol. 27, No. 2/3, p 201-230, April, 1983. 196 Ref. Science and Engineering Research Council Grant GR/B/18263.

Descriptors: *Organic compounds, *Pollutant identification, *Analytical methods, Chromatography, Wastewater analysis, Water analysis, Drinking water, Spectrometry, Literature reviews.

Methods currently available for the determination of organic micropollutants in water and wastewater are evaluated in this review. The groups of compounds considered are those which appear in both the EEC Blacklist and Greylist and the U.S. EPA Priority Pollutant list. These include specifically, polynuclear aromatic hydrocarbons, phlychlorinated biphenyls, organochlorine insecticides, phthalic acid esters, chlorophenols, phenols, organophosphorus compounds and other selected compounds of concern. General measures of organic pollution are considered, together with a range of chromatographic and instrumental methods for the analysis of specific groups of pollutants. The most widely used techniques for the measurement of specific compounds are gas liquid chromatography and high performance liquid chromatography. Mass spectrometry and combined gas liquid chromatography/mass spectrometry are the most definitive analytical methods. Solvent extraction procedures are the most suitable for non-volatile organic substances, and gas purging or stripping techniques are favored for the isolation of volatile compounds. Sample purification or clean-up procedures, including column and thin layer chromatography, are of particular importance when waste water samples are to be analyzed, owing to the relatively high concentrations of extraneous materials which have to be removed prior to analysis. (Baker-IVI)
W84-03996

POLLUTION INDICATORS AND POTENTIAL PATHOGENIC MICROORGANISMS IN ESTUARINE RECREATIONAL WATERS,
Nova Scotia Research Foundation, Dartmouth.
W. J. Robertson.
Canadian Journal of Public Health, Vol. 75, No. 1, p 19-24, January/February, 1984. 50 Ref.

Descriptors: *Bioindicators, *Pathogenic bacteria, *Estuaries, *Recreation, Water quality, Pathogens, Fecal coliform, Coliforms, Bacteria, Vibrio parahaemolyticus, Pseudomonas aeruginosa, Salmonella, Candida albicans, Canada.

The quality of marine recreational waters is now assessed using fecal coliforms, the recognized indicator of fecal contamination. It is assumed that the possibility of infections from water-borne pathogens increases as densities of fecal coliform increase. Fecal streptococci are also used as supplementary indicators. However, these indicators possess certain traits which limit their applicability. Within the last few years relatively easy techniques for enumerating the more common water-borne pathogens themselves have been developed, eg. Candida albicans, Pseudomonas aeruginosa, Salmonella and Vibrio spp. Studies are now underway to determine whether their densities correlate well with the presence of fecal indicators, in marine recreational waters. In estuaries the potential pathogen Vibrio parahaemolyticus appears to hold promise as a complementary indicator of the presence of sewage and other potential pathogens. (Author's abstract)
W84-04009

BACTERIAL INDICATORS OF RECREATIONAL WATER QUALITY,
Health Effects Research Lab., Cincinnati, OH.
A. P. Dufour.
Canadian Journal of Public Health, Vol. 75, No. 1, p 49-56, January/February, 1984.

Descriptors: *Bacteria, *Bioindicators, Water quality, Recreation, Escherichia coli, Enterococci, Coliforms, Fecal coliforms, Human pathology, Gastroenteritis, Comparison studies.

The currently recommeded bacterial indicator for measuring the quality of recreational waters in the United States is the fecal coliform group. Correlation analysis was performed on the swimming-associated gastroenteritis rates and the corresponding geometric mean densities of each indicator from multiple beaches and study units. The correlation coefficient was used as the measure of the 'strength' of the relationship between each indicator of water quality and swimming-associated gastroenteritis. The results of the marine and freshwater studies indicate that one bacterial indicator (enterococci) meets most of the ideal characteristics. Most important is the fact that the density of this indicator correlated well with gastrointestinal disease associated with swimming. The regression line of swimming-associated gastrointestinal illness rates on enterococci density indicates that the illness rate approaches zero before the indicator density reaches one. E. coli density showed a strong relationship to health risk in freshwater, but not in seawater whereas fecal coliform density was not related to swimming-associated gastroenteritis in either aquatic environment. Although none of the indicators examined could fulfill all of the suggested characteristics, enterococci were able to meet more of them than E. coli or fecal coliforms. The epidemiologic method does not require establishing pathogen to indicator relationships since only illness incidence is measured. (Murphy-IVI)
W84-04012

SIMULTANEOUS DETERMINATION OF DISSOLVED ORGANIC CARBON AND PHOSPHORUS IN WATERS USING FLAME IONIZATION AND PHOTOMETRIC DETECTORS,
Government Industrial Research Inst., Tosu (Japan).
K. Nakajima.
Water Resources, Vol. 18, No. 5, p 555-559, 1984. 4 Fig, 3 Tab, 16 Ref.

Descriptors: *Simultaneous determination, *Flame ionization, *Photometry, Dissolved organic carbon, Dissolved phosphorus, Organic carbon, Phosphorus, Water quality.

An apparatus with flame ionization and photometric detectors was assembled for the simultaneous determination of dissolved organic carbon (DOC) and phosphorus (DP) in waters. The optimum operating conditions were described. The long-term precision (relative standard deviation) is 5.8% for DOC and 5.2% for DP. The detection limits are 0.09 microg/ml for DOC and 0.03 microg/ml for DP. The responses for various DOC and DP compounds agreed almost with those obtained by combustion-infrared and persulfate digestion-colorimetric methods, respectively. DOC and DP in several water samples were determined by this method and other methods, and the results obtained by those methods were discussed. (Author's abstract)
W84-04022

ATOMIC ABSORPTION SPECTROMETRIC DETERMINATION OF ARSENITE IN WATER SAMPLES BY GRAPHITE FURNACE AFTER EXTRACTION WITH AMMONIUM SEC-BUTYLDITHIOPHOSPHATE,
Texas A and M Univ., College Station. Dept. of Chemistry.
D. Chakraborti, K. J. Irgolic, and F. Adams.
Journal Association of Official Analytical Chemists, Vol. 67, No. 2, p 277-280, March-April, 1984. 2 Fig, 3 Tab, 20 Ref.

Descriptors: *Arsenite, Water analysis, Atomic absorption spectrophotometry.

Arsenite-but not arsenate, methylarsonic acid, or dimethylarsinic acid-is extracted from water samples by 5 mL of a 0.01M hexane solution of sec-dibutylthiophosphate. A 10 microL aliquot of the extract is injected into an atomic absorption spectrometer with a graphic furnace for the determination of arsenic. The calibration curve is linear to 1500 ng As. Quantities of arsenic as low as 100 ng As (0.2 ppb As when contained in 500 mL) can be confidently determined. The method was tested with natural river water and synthetic river water. The relative standard deviations associated with the recoveries of arsenite from natural water and synthetic river water spiked with arsenite range from 4.8 to 8.0%. Ten to 15 arsenite determinations can be completed in 1 h. (Author's abstract)
W84-04032

SAMPLING STRATEGY FOR RIVER POLLUTANT TRANSPORT,
Corps of Engineers, Buffalo, NY. Buffalo District.
S. M. Yaksich, and F. H. Verhoff.
Journal of Environmental Engineering, Vol. 109, No. 1, p 219-231, February, 1983. 3 Fig, 5 Tab, 7 Ref, 1 Append.

Descriptors: *Sampling strategy, *River flow, *Pollutant transport, Event response rivers, Stable response rivers, Suspended sediments, Phosphorus, High flow.

Estimates of the amount of pollutants which are carried by rivers from land sources to receiving water bodies are calculated from measurements of river flow rate and pollutant concentration. River flow can be measured frequently, but pollutant concentration will usually be sampled infrequently during the period of transport. A strategy is developed for sampling the pollutant concentration so that the errors in the transport estimates are minimal. Two types of rivers exist: event response rivers where suspended sediment concentrations and sediment adsorbed parameters increase with increasing flow; and stable response rivers where suspended sediment and adsorbed parameter concentrations do not increase with increasing flow. Each type of river requires its own sampling strategy. High flow events must be sampled on event response rivers to obtain reliable suspended sediment and total phosphorus flux estimates. The best method to calculate the flux with this data is an interval method. If these events are not sampled, fluxes will be underestimated by 15%-30%. Event sampling is not important for event response rivers which are impacted by point sources. For stable response rivers and parameters which do not change with flow, event sampling is not required. (Moore-IVI)
W84-04050

ANALYSIS OF TETRAHYDROTHIOPHENE IN WATER BY HEADSPACE HIGH-RESOLUTION GAS CHROMATOGRAPHY-MASS SPECTROMETRY,
Istituto di Ricerche Farmacologiche Mario Negri, Milan (Italy). Lab. of Environmental Pharmacology and Toxicology.
G. Carlucci, L. Airoldi, and R. Fanelli.
Journal of Chromatography, Vol. 287, No. 2, p 425-428, April, 1984.

Descriptors: *Tetrahydrothiophene, Sulfur compounds, Water pollution, Leachates, Gas chromatography.

Tetrahydrothiophene (THT) is widely used as a warning odorant for odorless fuel, city and natural gases and recently also for herbicides. Headspace gas chromotography was developed to monitor THT contamination of soil and spring-waters surrounding an area where a container had been incorrectly disposed. The procedure is highly sensitive to quantitate THT in water. The method appears to be useful for detecting water contamination by THT at levels as low as 10 ng/ml. (Murphy-IVI)
W84-04052

DETERMINATION OF TRACE LEVELS OF HEAVY METALS IN WATERS BY EXTRACTION WITH AMMONIUM TETRAMETHYLENEDITHIOCARBAMATE AND HEXAMETHYLENEAMMONIUM HEXAMETHYLENEDITHIOCARBAMATE INTO XYLENE FOLLOWED BY INDUCTIVELY-COUPLED PLASMA EMISSION SPECTROMETRY,
National Research Inst. for Pollution and Resources, Ibarkai (Japan).
H. Tao, A. Miyazaki, K. Bansho, and Y. Umezaki.
Analytica Chimica Acta, Vol. 156, p 159-168, 1984. 2 Fig, 5 Tab, 15 Ref.

Descriptors: *Pollutant identification, *Trace metals, *Metals, *Water analysis, Heavy metals, Spectrometry, Plasma emission spectrometry, Extraction, Sea water, Rivers.

The usefulness of extraction with ammonium tetramethylenedithiocarbamate (APDC)/hexamethyleneammonium hexamethylenedithiocarbamate (HMAHMDC)/xylene extraction system for the determination of ng/ml levels of metals in natural waters is demonstrated. Determination of cadmium, copper, chromium, cobalt, iron, manganese, molybdenum, nickel, lead, vanadium, and zinc are described in river and sea water using inductively-coupled plasma emission spectrometry following the extraction step. The main advantages of the method are the simultaneous extraction of the metals in a single extract and simultaneous multi-element measurements by direct introduction of the organic phase into the plasma, without back-extraction or evaporation of the extract which is liable to increase contamination and losses by adsorption or evaporation. The limits of detection of the method range from 0.017 ng/ml (cadmium) to 0.5 ng/ml (lead). Nitric acid and ammonia solution were super-special grade and HMAHMDC was used without purification. If these reagents are purified, the blank will be decreased and better detection limits will be achieved. With 100-fold concentration factors, calibration graphs are linear up to 30 ng/ml or more. (Baker-IVI)
W84-04059

ATOMIC ABSORPTION SPECTROMETRIC DETERMINATION OF ARSENIC AND SELENIUM IN MINERAL WATERS BY ELECTROTHERMAL ATOMIZATION,
Ljubljana Univ. (Yugoslavia). Dept. of Chemistry and Chemical Technology.
V. Hudnik, and S. Gomiscek.
Analytica Chimica Acta, Vol. 157, No. 1, p 135-142, February, 1984. 6 Fig, 4 Tab, 21 Ref.

Descriptors: *Pollutant identification, Water analysis, Arsenic, Selenium, Minerals, Electrothermal atomization, Atomic absorption spectrometry, Spectrometry, Mineral water, Slovenia, Yugoslavia.

The determination of arsenic and selenium by electrothermal atomic absorption spectrometry is complicated by interferences because of the uncontrollable volatility of arsenic and selenium compounds, especially in complex inorganic and organic matrices. Mineral waters contain alkali metals, alkaline-earth metals, sulfate, chloride, and hydrogen carbonate ios in high and changeable concentrations, whereas the concentrations of arsenic and selenium are normally very low. Arsenic and selenium are separated from the macrocomponents by co-precipitation in hydrated iron (III) oxide. The precipitate is dissolved in 0.2 M sulfuric acid for injection. The detection limits are 0.2 and 0.5 micrograms/l for arsenic and selenium, respectively. The proposed method was used in the analysis of some mineral waters from Slovenia (Yugoslavia). (Baker-IVI)
W84-04060

SEPARATION OF TELLURIUM(IV) FROM WATER AND SEA WATER BY FLOTATION WITH HYDRATED IRON(III) OXIDE,
Okayama Univ., Kurashiki (Japan). Inst. for Agricultural and Biological Sciences.
S. Nakashima, and M. Yagi.
Analytica Chimica Acta, Vol. 157, No. 1, p 187-191, February, 1984. 1 Tab, 28 Ref.

Descriptors: *Pollutant identification, *Trace elements, *Tellurium, Atomic absorption spectrometry, Spectrometry, Flotation, Separation, Water analysis, Seawater.

A flotation separation method is described for determining sub-microgram levels of tellurium(IV) from 1 liter samples of water and sea water. Tellurium(IV) is coprecipitated with hydrated iron(III) oxide at pH 8-9. The precipitate is floated with the aid of surfactant solutions and small nitrogen bubbles, separated and dissolved in dilute hydrochloric acid. Tellurium is then converted to hydrogen telluride with sodium tetrahydroborate and measured by atomic absorption spectrometry. Recovery of added tellurium (0.4 and 0.8 micro g/l) was about 83%. The time required for the preconcentration is 30 min per sample, including 15 min stirring. The atomic absorption measurement of hydrogen telluride is rapid and sensitive. (Baker-IVI)
W84-04061

CALIBRATION AND APPLICATION OF QUAL-II TO THE LOWER WINOOSKI RIVER,
Massachusetts Univ., Amherst. Dept. of Environmental Engineering.
J. Van Benschoten, and W. W. Walker, Jr.
Water Resources Bulletin, Vol. 20, No. 1, p 109-117, February, 1984. 5 Fig, 2 Tab, 17 Ref.

Descriptors: *Water quality, *Computer models, *QUAL-II, *Lower Winooski River, *Vermont, Simulation, Phosphorus, Algae, Dissolved oxygen, Nitrogen compounds, Nutrients, Dam effects.

A modified version of the QUAL-II water quality simulation model is calibrated and applied to the Lower Winooski River, Vermont. The Winooski River flows westerly through the Green Mountains to Lake Champlain. In constrast to the upper basin, which is predominantly rural, the final 32 km, the Lower Winooski has a population of about 90,000. Waste discharges from seven municipalities and one industry enter the Lower Winooski. There are two dams on the Lower Winooski for peak power generation. Several structural modifications are made in the model to improve water quality simulations in rivers impacted by algal growth; these include the addition of organic nitrogen and organic phosphorus compartments and provision for algal uptake of ammonia and/or nitrate nitrogen. The model is interfaced with statistical programs which facilitate tabulation, display, and analysis of observed and predicted concentrations. The model is calibrated and tested against data from two intensive water quality surveys. In applying the revised QUAL-II model to the Lower Winooski River, good agreement is evident between observed and predicted water quality constituents. From a water quality management standpoint, use of the model has helped in defining the importance of algae and point-source phosphorus inputs as factors influencing the Lower Winooski's dissolved oxygen regime. (Moore-IVI)
W84-04111

ENUMERATION OF BACTEROIDES FRAGILIS GROUP ORGANISMS FROM SEWAGE AND NATURAL WATERS,
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
K. Allsop, and D. J. Stickler.
Journal of Applied Bacteriology, Vol. 56, No. 1, p 15-24, February, 1984. 8 Tab, 30 Ref.

Descriptors: *Bacteroides, *Bacterial analysis, *Water analysis, *Wastewater analysis, Feces, Indicator organisms, Coliforms, Membrane filtration.

The Bacteroides fragilis group (BFG) contains obligately anaerobic, Gram negative, non-motile, non-sporing bacteria. These species, the most numerous bacteria in human feces, are also known to occur in the intestinal tract of some warm blooded animals. Their presence in human feces in numbers approximately 100-fold greater than those of Escherichia coli suggests that Bacteroides spp. might be an alternative to coliform organisms as indicators of fecal contamination of water. A membrane filtration technique has been developed for the enumeration of BFG organisms from sewage and natural waters. The method used Wilkins and Chalgren agar medium supplemented with gentamicin, penicillin, aesculin and ferric ammonium citrate. Membrane filters with 0.22 micro m pores were significantly more efficient than those with 0.45 micro m pores in the isolation of BFG. A preliminary incubation period of 4 h at 30 C prior to 44 h at 37 C yielded significantly higher numbers of BFG than direct incubation at 37 C for 48 h. (Moore-IVI)
W84-04163

NEW GENERAL ESTIMATION OF RIVER POLLUTION USING NEW DIATOM COMMUNITY INDEX (NDCI) AS BIOLOGICAL INDICATORS BASED ON SPECIFIC COMPOSITION OF EPILITHIC DIATOMS COMMUNITIES. APPLIED TO ASANO-GAWA AND SAIGAWA RIVERS IN ISHIKAWA PREFECTURE,
Meiho High School, Kanazawa City (Japan).
For primary bibliographic entry see Field 5C.
W84-04170

INDIRECT DETERMINATION OF CYANIDE IN WATER BY ATOMIC-ABSORPTION SPECTROPHOTOMETRY,
Shanghai Normal Univ. (China). Dept. of Chemistry.
B.-X. Xu, T.-M. Xu, and Y.-Z. Fang.
Talanta, Vol. 31, No. 2, p 141-143, February, 1984. 2 Fig, 3 Tab, 11 Ref.

Descriptors: *Cyanide, *Atomic absorption spectrophotometry, Lead, Anions, Industrial wastewater, Huang Pu River, China.

The standard method for determining trace cyanide in water is colorimetry, but it involves preseparation and use of a carcinogenic reagent (benzidine). An indirect method for determination of trace cyanide in water by atomic-absorption spectrophotometry is described. Cyanide forms a stable complex anion with Pd in alkaline solution. This complex anion can form an ion-association complex with tetra-alkylammonium ions which can be extracted into n-butyl alcohol with an efficiency higher than 90%. The extract can be analysed directly for palladium (and hence indirectly for cyanide) by flame atomic-absorption spectrophotometry. The detection limit for cyanide by this method is 0.1 microg/ml in the n-butyl alcohol extract. Beer's law is obeyed for 0.13-9 microg of CN(-) per ml of n-butyl alcohol. Several foreign ions do not interfere. (Murphy-IVI)
W84-04187

5B. Sources Of Pollution

INVESTIGATIONS OF THE ECOTOXICOLOGICAL EFFECT OF A HERBICIDE IN AN AQUATIC MODEL ECOSYSTEM; II. FOOD CHAIN SIGNIFICANCE AND PESTICIDE BALANCE (UNTERSUCHUNGEN ZUR OKOTOXIKOLOGISCHEN WIRKUNG EINES HERBIZIDS IN EINEM AQUATISCHEN MODELLOKOSYSTEM; II. NAHRUNGSKETTENPROBLEME UND SCHADSTOFFBILANZIERUNG),
Technische Univ., Berlin (Germany, F.R.). Inst. fuer Technischen Umweltechutz.
V. G. Gunkel.
Archiv fur Hydrobiologie, Vol. 1, p 130-168, Stuttgart, January, 1984. 16 Fig, 6 Tab, 60 Ref.

Descriptors: *Herbicides, *Toxicity, *Ecosystems, Atrazine, S-triazine, Bioaccumulation, Phytoplankton, Benthic fauna, Fish, Fate of pollutants, Food chains.

Herbicides are currently extensively used throughout developing countries. Although it is known what effects herbicides have on the specific target species, the general effects to the ecosystem is not widely studied. To determine the bioaccumulation of the herbicide (atrazine, s-triazine), a small pond was investigated during a vegetation period. The herbicide residues were determined in organisms at different trophic levels (phytoplankton, macrophytes, zooplankton, and fishes). High bioconcentration factors occur in phytoplankton during periods of small phytoplankton biomasses. Organisms of high trophic levels only reach small bioconcentration factors, and no food-chain effect can be observed under consideration of benthic and pelagic consumers. The phytoplankton accumulates atrazine to a varying level, ranging from 27 up to 1200. The level of the atrazine residue is not closely correlated with the phytoplankton species. High bioconcentration factors occur only in small phytoplankton biomasses. Daphnia pulicaria (Cladocera), a filtering zooplankton organism, accumulates less atrazine than phytoplankton; bioconcentration factors are less than 16. In water-free, dried bottom which consists mainly of organic material, concentration factors of 20 to 45 are observed. Larvae of sediment-eating Chironomus possess atrazine residues smaller than those found in the sediment with bioconcentration factors of 1.4 to 4.8. Fishes as final consumers of the experimental system possess only small bioconcentration factors, less than 9. Most of the herbicide is dissolved in the water with other losses to plants, animals, the sediment, the air and outflow. At the end of the experiment atrazine is distributed between the compartments of the pond system - water, sediment, atmosphere, phytoplankton, and zooplankton in the ratio 11400:660:5:2:1. (Murphy-IVI)
W84-03514

SEASONAL CHANGES IN THE CONCENTRATION AND COLOUR OF HUMIC SUBSTANCES IN SOME AQUATIC ENVIRONMENTS,
Laval Univ., Quebec. Dept. of Soil Science.
S. A. Visser.
Freshwater Biology, Vol. 14, No. 1, p 79-87, February, 1984. 5 Fig, 3 Tab, 37 Ref.

Descriptors: *Concentration, *Color, *Humic acids, Aquatic environment, Organic matter, Fulvic acids, Precambrian shield, Quebec.

Over 40% of the organic matter present in natural waters consists of complex heterogenous yellow or brown acidic polymers collectively known as humic matter. Between February and September 1974, concentrations of fulvic and humic acids in waters from a cryoboreal region of the Precambrian Shield in Quebec varied between 0.5-6.1 mg/l and 0.1-6.5 mg/l respectively. Whereas the fulvic acids usually remained relatively constant during this period, humic acids showed appreciable increases. The number and weight average molecular weights of the fulvic acids (approximately 5000 and approximately 22,000 daltons respectively) were lower than those of the humic acids (approximately 20,000 and approximately 75,000 respectively). The average molecular weight of the aquatic humic matter often decreased during late summer and early autumn. During spring floods the molecular weight of fulvic acids increased and that of humic acids declined. Because the aquatic humic acids were more intensely colored than fulvic acids, they contributed more than 30% of the color of the water even though they accounted for only 15% of the concentration of humic matter. The color intensity of both fulvic and humic acids generally appeared to increase during the latter part of the summer, when there was normally a decrease in the value of the color quotient (E4/E6 ratio), indicating the accumulation in the waters of more humified material. (Murphy-IVI)
W84-03532

DISSOLVED HEAVY METALS IN A LACUSTRINE MINE TAILINGS DEPOSIT-BUTTLE LAKE, BRITISH COLUMBIA,
British Columbia Univ., Vancouver. Dept. of Oceanography.
T. F. Pedersen.
Marine Pollution Bulletin, Vol. 14, No. 7, p 249-254, 1983. 2 Fig, 2 Tab, 10 Ref. Natural Sciences and Engineering Research Council of Canada grant UO139.

Descriptors: *Heavy metals, *Mine wastes, *Lacustrine wastes, *Buttle Lake, *British Columbia, Zinc, Copper, Cadmium, Lakes, Open-pit mining, Mine drainage, Pollution load, Sedimentation.

The degree of post-depositional (diagenetic) reactivity of submerged mine tailings in fresh water in Buttle Lake, British Columbia, is assessed by inves-

tigating the distribution of Zn, Cu, Cd, Mn and Fe in interstitial water profiles collected from the upper meter of the tailings deposit and from proximal natural sediments. These dissolved Zn, Cu and Cd concentrations indicate that the tailings are not releasing heavy metals to the overlying lake water at present, and there is no evidence to suggest that significant oxidation is occurring in the deposit. The lake waters are enriched in metals from surface drainage, however, while pore waters in natural sediments are heavy-metal-depleted. Diffusion into the natural sediments therefore tends to buffer the lacustrine metal load, but only to a very limited extent. Modern open-pit mining operations often generate large quantities of mill tailings. Terrestrial disposal of this waste is expensive and may have serious environmental consequences, including surface water contamination from acidic drainage enriched in leached heavy metals. Submarine disposal, in contrast, is relatively inexpensive and has often been justified on the grounds that tailings have low chemical reactivity in marine or lacustrine waters. As a result coastal and inland waters in many areas of the world are being used increasingly as tailings disposal sites. However, recent field and laboratory studies have demonstrated that under certain conditions, tailings do release dissolved metals upon exposure to seawater. (Murphy-IVI)
W84-03536

LEVELS OF ORGANOCHLORINE COMPOUNDS IN AN INLAND SEAL POPULATION IN EASTERN FINLAND,
Joensuu Univ. (Finland). Dept. of Biology.
E. Helle, H. Hyvarinen, H. Pyysalo, and K. Wickstrom.
Marine Pollution Bulletin, Vol. 14, No. 7, p 256-260, 1983. 2 Fig, 5 Tab, 17 Ref.

Descriptors: *Organochlorine compounds, *Seal populations, *Finland, Saimaa seals, Polychlorinated biphenyls, DDT, Chlordane, Chlorophenol, Population exposure, Ecological effects, Water pollution effects, Bioaccumulation, Lake Saimaa.

The Saimaa seal population has decreased rapidly in recent decades and the population is now estimated to be only 100-odd individuals. Until now the possible role of environmental toxins in the reduction of the Saimaa seal population has remained undetermined. Fourteen Saimaa ringed seals (Phoca hispida saimensis) were studied for PCB, DDT, chlordane and chlorophenol compounds in blubber, liver, muscle, heart and kidney in Lake Saimaa, eastern Finland, in 1977-1981. Both PCBs and total DDT increased on average from a good 5 mg/kg in extractable fat of blubber in a new-born to a good 65 mg/kg in sexually mature specimens, the maximum being 93 and 104 mg/kg respectively. Concentrations of PCBs and tDDT in blubber and liver were most clearly dependent on the age and weight of the seal. Chlordanes were found in all 14 specimens (mean 0.59 mg/kg in blubber), trichlorophenol in one, tetrachlorophenol in two and pentachlorophenol in all three specimens studied. Although some of the Saimaa seals had reached quite high levels of both PCBs and tDDT, the present results do not indicate that the steady decrease of the Saimaa seal population during the last two decades would have been caused by these toxins, at least not in isolation. (Murphy-IVI)
W84-03538

HEAVY METALS IN MARINE NEMATODES: UPTAKE, TISSUE DISTRIBUTION AND LOSS OF COPPER AND ZINC,
Newcastle upon Tyne Univ. (England). Dept. of Zoology.
R. Howell.
Marine Pollution Bulletin, Vol. 14, No. 7, p 263-268, 1983. 3 Fig, 2 Tab, 18 Ref.

Descriptors: *Heavy metals, *Nematodes, *Tissue analysis, *Copper, *Zinc, Bioindicators, Hypodermis, Cuticle, Fate of pollutants, Budle Bay, Blyth estuary, Estuaries, Bioaccumulation, Seawater, England.

The uptake and loss of copper and zinc was studied in two species of marine nematode from a non-polluted site and in one species from a polluted site. Copper and zinc concentrations were measured during and after accumulation from seawater in six different tissues of the nematodes. The rapid uptake and loss of both copper and zinc by the cuticle of all three groups suggests that the primary event is surface adsorption. The role of the 'other tissues' is difficult to assess. This group included the hypodermis which is known to be highly metabolically active and as well as secreting the cuticle is thought to be the site of many physiological processes in the body. As such it represents a highly specific target for toxicants of the heavy metal type, which are known to interfere with a wide variety of enzymes and cellular systems. (Murphy-IVI)
W84-03540

OLD CANNERY WASTES, A POTENTIAL SOURCE OF TRACE METALS IN THE MARINE ENVIRONMENT,
Northwest Consultant Oceanographers, Inc., Seattle, WA.
L. C. Loehr, and E. E. Collias.
Marine Pollution Bulletin, Vol. 14, No. 10, p 392-394, 1983. 1 Fig, 2 Tab, 4 Ref.

Descriptors: *Trace metals, *Cannery wastes, *Marine environment, Lead, Zinc, Mussels, California, Monterey Bay, Cypress Point, Cannery Row, Wastewater outfall, Bioaccumulation, Fate of pollutants, Wastewater pollution.

High levels of lead and zinc have been measured in the California Mussel Mytilus californianus taken from southern Monterey Bay as part of the California State Mussel Watch program. The levels of lead and zinc increase steadily from Cypress Point towards Cannery Row. The California State Water Resources Control Board (which funded but did not conduct the State Mussel Watch) has attributed the high levels to heavy metals contributed by sewage. The state mussel watch data reports have not considered the historic canning wastes from more than 30 canneries along Cannery Row as a possible source of trace metals. Leachates from old cannery wastes may be a major source of lead and zinc in mussels in southern Monterey Bay and must be considered in assessing any data from the State Mussel Watch program. (Author's abstract)
W84-03542

TOTAL MERCURY, METHYL MERCURY AND SULPHIDE IN RIVER CARRON SEDIMENTS,
Leicester Polytechnic (England). School of Chemistry.
P. J. Craig, and P. A. Moreton.
Marine Pollution Bulletin, Vol. 14, No. 11, p 408-411, 1983. 2 Fig, 1 Tab, 8 Ref.

Descriptors: *Mercury, *Methyl mercury, *Sulfide, *Carron River, *Sediments, Wastewater disposal, Fate of pollutants, Estuaries, Scotland.

Methyl mercury levels are controlled more by the sulfide content in sediments than by factors such as total mercury levels or organic content. Total mercury, methyl mercury and sulfide contents of River Carron sediments (Lothian, Scotland) have been determined. Total mercury concentrations are comparable to other mercury polluted estuaries in the UK, but the methyl mercury values for low-sulfide Carron sediments are generally higher. The methyl mercury levels are initially in direct proportion to the sulfide concentrations of the sediments but beyond sulfide concentrations of 1.8 mg/g the methyl mercury levels decline sharply. (Murphy-IVI)
W84-03543

AERIAL FLUX OF PARTICULATE HYDROCARBONS TO THE CHESAPEAKE BAY ESTUARY,
Old Dominion Univ., Norfolk, VA. Dept. of Oceanography.
D. B. Webber.
Marine Pollution Bulletin, Vol. 14, No. 11, p 416-421, 1983. 2 Fig, 1 Tab, 47 Ref. EPA grant X00322501.

Descriptors: *Particulate matter, *Hydrocarbons, *Chesapeake Bay, *Estuaries, Deposition, Municipal wastewater, Water pollution, Air pollution effects, Fate of pollutants, Air pollution.

To delineate the magnitude of the atmospheric input of high molecular weight hydrocarbons, deposition rates were measured over a 15 month period at four stations in south-eastern Virginia surrounding the lower Chesapeake Bay. A nearly linear trend of atmospheric particulate deposition was recorded. Deposition rates at the urban station (195 microg/sq m/day) were approximately three times greater than those recorded for nonurban and coastal locations (mean value 69 microg/sq m/day). The increased levels at the urban location were attributed to localized source inputs. Anthropogenic hydrocarbons accounted for approximately 50% of the total deposition at all stations. Significant biogenic inputs were indicated by the odd/even n-alkane distribution. A minimum flux to the water surface, based on mean nonurban deposition rates (24 mg/yr), indicated an annual particulate hydrocarbon flux of +275 metric tons. Little information is available for the comparison of additional source inputs; however, the data reported here indicate that the aerial deposition of hydrocarbons is of the same order of magnitude as the input from municipal wastewater facilities and accidental discharge and is a potentially signficant source of hydrocarbon pollution to the Chesapeake Bay Estuary. (Murphy-IVI)
W84-03544

TRACE METAL DISTRIBUTIONS IN SAINT JOHN HARBOUR SEDIMENTS,
Department of Fisheries and Oceans, St. Andrews (New Brunswick).
S. Ray, and S. D. MacKnight.
Marine Pollution Bulletin, Vol. 15, No. 1, p 12-18, January, 1984. 8 Fig, 4 Tab, 15 Ref.

Descriptors: *Trace metals, *Saint John Harbor, *Sediments, Sedimentation, Dredging, Estuaries, Distribution, New Brunswick, Canada, Anthropogenic input.

The Saint John River has the largest estuary in the Province of New Brunswick, Canada. Its harbor is extensively used during the whole year and requires regular maintenance dredging. The open-water disposal site for the dredged material is situated off Black Point. The concentration and areal distribution of selected trace metals (Cu, Zn, Pb, Cd, Mo, Ni, Mn and Hg) in surficial sediments of Saint John Harbor, were studied to determine the extent of anthropogenic input and to estimate the effects of dumping dredged material in the outer harbor. Hg and Cd are of special concern, since the disposal of dredge material containing these two elements is regulated under the Ocean Dumping Control Act. The concentrations of all metals are low: Cu 16, Zn 53, Pb 24, Cd 0.16, Mo 3, Ni 16, Mn 296 and Hg 0.04 microg/g. Hg and Cd levels in sediment are well below the permissible limits of 0.75 and 0.6 microg/g, respectively, set by the Ocean Dumping Control Act. The mean concentrations of trace elements are similar to the low mean values in the unpolluted Bay of Fundy. There is an overall decline in concentrations of metals in the sediments from the inner to the outer harbor. Comparison of the metal levels in the sediments from different areas within the harbor indicate that there is a detectable anthropogenic input in the Courtenay Bay area. Trace metal levels at the dumpsite are significantly lower than in the Courtenay Bay area, where the bulk of the dredged material originates. (Murphy-IVI)
W84-03545

SURFACE-WATER QUALITY IN THE CAMPBELL CREEK BASIN, ANCHORAGE, ALASKA,
Geological Survey, Anchorage, AK. Water Resources Div.
T. P. Brabets, and L. A. Wittenberg.
USGS Water-Resources Investigations Report 83-4096, 1983. 28 p, 20 Fig, 12 Tab, 11 Ref.

Descriptors: *Urban hydrology, *Water quality, Urban runoff, Streamflow, *Alaska, Anchorage, Campbell Creek basin.

Four streams in the Campbell Creek Basin were sampled during different flow conditions for an 18-month period. North Fork Campbell and South Fork Campbell Creeks drain areas virtually undisturbed by man's activities. The other two streams, Little Campbell Creek and the main stem Campbell Creek, drain areas that have been urbanized. The water from South Fork Campbell and North Fork Campbell Creeks is of good quality and does not adversely affect the water quality of the main stem Campbell Creek. Little Campbell Creek, which has been affected by urbanization, impacts the water quality of Campbell Creek during low-land snowmelt periods when discharges from South Fork Campbell and North Fork Campbell Creeks are small. High concentrations of suspended sediment in Campbell Creek may be contributed by Little Campbell Creek. Fecal-coliform bacteria concentrations are highest at Little Campbell Creek and probably account for most of the high coliform concentrations at Campbell Creek. (USGS)
W84-03592

WATER QUALITY AND OTHER HYDROLOGIC DATA COLLECTED IN AND AROUND A SURFACE COAL MINE, CLAY AND VIGO COUNTIES, INDIANA, 1977-80,
Geological Survey, Indianapolis, IN. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-03597

HYDROLOGY OF THE LITTLE ANDROSCOGGIN RIVER VALLEY AQUIFER, OXFORD COUNTY, MAINE,
Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W84-03607

SOUTH JEFFERSON STREAM QUALITY ASSESSMENT PROGRAM,
Clarkson Coll. of Technology, Potsdam, NY. Dept. of Civil and Environmental Engineering.
J. V. DePinto.
Report, Temporary State Commission on Tug Hill, Watertown, N.Y., November, 1977. 19 p, 1 Fig, 4 Tab, 2 Ref.

Descriptors: *Water quality, *Stream pollution, *Chemical analysis, *Stream profiles, *Water sampling, *Bacterial analysis, Stream biota, Watersheds, Large watersheds, Streamflow, Eutrophication, Nutrients, Land use, Acidity, Acid streams, Water temperature, Alkalinity, Dissolved oxygen, Biological oxygen demand, Dissolved solids, Suspended solids, Phosphorus, Coliforms, Ammonia, Nitrogen, Nitrates.

This program was designed to provide an educational experience for a group of supervised Jefferson County High School students and to obtain specific data which will allow relationships to be seen between the Lake Ontario eastern coastal zone and upland watersheds on Tug Hill. The program will also serve as a benchmark for future studies by providing information by which to gauge future water quality, and the information is available to local towns. The students performed both qualitative observation of some of the important streams and periodic quantitative analysis of stream water quality by laboratory testing of water samples collected at nine sites. The following parameters were tested: pH, alkalinity, temperature, dissolved oxygen, BOD5, suspended and dissolved solids, ammonia-nitrogen, nitrate-nitrogen, total phosphorus, and total coliform. Stream flow was estimated, too. The overall water quality of the South Jefferson County streams sampled in the study is good, and, discounting the presence of toxic substances, these streams should support a healthy, diverse aquatic community. In general, the downstream water quality appears to be slightly lower (increase in BOD5, solids, and total phosphorus). The nutrient loadings to Lake Ontario are such that the nearshore bays receiving these nutrients might eventually suffer the effects of eutrophication. The major land use impact on stream water quality appears to be the effect of the village of Adams on Sandy Creek. (Fazio-Omniplan)
W84-03654

ADDENDUM TO THE SURFACE WATER QUALITY REPORT,
Disko (M.) Associates, Union, NJ.
M. Disko, and T. Marturano.
Report, September 1981. 344 p, 73 Fig, 103 Tab.

Descriptors: *Surface water, *Surface-groundwater relations, *Computers, *Computer programs, *Water quality data, *Stream profiles, Stream discharge, Streams, Catchment areas, Wastewater disposal, Water quality, Dissolved solids, Data analysis.

The preliminary report in 1978 contained an analysis of only five of 21 parameters actually measured, because of a time constraint imposed by problems with the state's STORET computer system. Since there was not statistical analysis of the data available, the preliminary report contained only information pertaining to the percentage of time each station violated a state standard. Analyses in the report should not be correlated with results in the 1978 report because numerous data corrections as well as three months of additional testing changed the statistical averages. Instead of using STORET's analytical capabilities, a more flexible program, Statistical Analysis Systems, was used to analyze the data. Twelve of the fifty-seven stations have been designated as trout maintenance waters. There is an increase in the dissolved oxygen standard from five to six mg/l. Other standards at the time of the sampling were turbidity, pH, fecal coliform, total dissolved solids, and total phosphorus. Since Ocean County soils are naturally acidic, the average pH of the area is well below the 6.5 standard. The total dissolved solids standard for these water is 133 percent of the background value. The water quality in Crosswicks Creek was found to be one of the poorest in the county. Almost every parameter recorded its highest concentration at this station, sometimes several times larger than the county average. In general, it appears that poorer water quality is in the north and western parts of the county. (Garrison-Omniplan)
W84-03678

BIOACCUMULATION MONITORING IN THE NEW YORK BIGHT USING THE BLUE MUSSEL (MYTILUS EDULIS),
Army Engineer District, New York.
For primary bibliographic entry see Field 5C.
W84-03683

VARIABILITY OF SURFACE RECHARGE AND ITS EFFECTS ON GROUNDWATER IN SUFFOLK COUNTY, LONG ISLAND,
Cornell Univ., Ithaca, NY. Center for Environmental Research.
W. H. Brutsaert, and T. S. Steenhuis.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84 154376, Price codes: A02 for paper copy, A01 for microfiche. Completion Report, September, 1983. 9 p, 4 Fig, 4 Ref. Project No. OWRT A-095-NY (1), Contract/Grant No. 14-34-0001-2134.

Descriptors: Groundwater pollution, Infiltration, Spatial variability, Unsaturated flow, Long Island, Porous media flow, Path of pollutants, *New York, Suffolk County, Groundwater recharge, Soil contamination.

The overall objective was to gain more insight in the variability of downward movement of water, which is the main carrier agent of pollutants in the soil. The study focused on Eastern Long Island where conditions of groundwater pollution are especially severe. For this purpose the infiltration properties of a Haven loam were determined in the laboratory by means of a newly-designed vertical capillary rise apparatus on 180 disturbed field samples of topsoil and subsoil. The experimental data were first processed by means of several concise formulations for sorption; measured and determined for each sample were rate of wetting front advance, three forms of sorptivity and four diffusivities. Subsequently a geostatistical analysis was performed and applied to the subsoil sorptivity data. The understanding gained in this project will be incorporated in predictive modeling techniques for the transport of toxic chemicals to the groundwater.
W84-03693

VIRUS MOVEMENT IN SOIL DURING SATURATED AND UNSATURATED FLOW,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
J. C. Lance, and C. P. Gerba.
Applied and Environmental Microbiology, Vol. 47, No. 2, p 335-337, February, 1984. 1 Fig, 3 Tab, 13 Ref. EPA project R-805,292.

Descriptors: *Viruses, *Soil water, *Saturated flow, *Unsaturated flow, Soil columns, Wastewater disposal, Water reuse, Poliovirus, Soil absorption capacity.

Virus movement in soils has received much attention because land application of wastewater offers a unique opportunity to turn the wastewater into a valuable water resource while minimizing the pollution of surface water. Virus movement in soil during saturated and unsaturated flow was compared by adding poliovirus to sewage water and applying the water at different rates to a 250-cm-long soil column equipped with ceramic samplers at different depths. Movement of viruses during unsaturated flow of sewage through soil columns was much less than during saturated flow. Viruses did not move below the 40-cm level when sewage water was applied at less than the maximum infiltration rate; virus penetration in columns flooded with sewage was at lease 160 cm. Therefore, virus movement in soils irrigated with sewage should be less than in flooded groundwater recharge basins or in saturated soil columns. Management of land treatment systems to provide unsaturated flow through the soil should minimize the depth of virus penetration. Differences in virus movement during saturated and unsaturated flow must be considered in the development of any model used to simulate virus movement in soils. (Murphy-IVI)
W84-03703

PENETRATION OF DIFFERENT HUMAN PATHOGENIC VIRUSES INTO SAND COLUMNS PERCOLATED WITH DISTILLED WATER, GROUNDWATER, OR WASTEWATER,
Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene.
H. Dizer, A. Nasser, and J. M. Lopez.
Applied and Environmental Microbiology, Vol. 47, No. 2, p 409-415, February, 1984. 7 Fig, 22 Ref.

Descriptors: *Viruses, *Sand columns, *Percolating water, *Distilled water, *Groundwater, *Wastewater, Water reuse, Decontamination, Drinking water, Adsorption, Tertiary effluent, Groundwater recharge, Infiltration, Percolation rate.

Thanks to the adsorption processes in aquifers and to the metabolism of their microflora, groundwater, if contaminated, has the tendency to regenerate itself. This makes an underground recharge of tertiary treated wastewater an ideal last step before the wastewater is reused. The adsorption of several enteroviruses and rotavirus SA11 to sand from an aquifer in the Federal Republic of Germany was estimated in sand-filled columns loaded with ca. 107 PFU and run at a velocity of 2.5 m/day for 12 h. After either distilled water, groundwater, secondary effluent, or tertiary effluent was percolated, the sand core was slowly extruded out of the column and cut in 1-cm slices. The slices were eluted with nutrient broth, and the amount of viruses in the broth was estimated. The best adsorption was promoted by groundwater and tertiary effluent, followed by distilled water and secondary effluent. Similar experiments, carried out at different percolation rates, indicated that a 50-day

underground stay of recharged water probably suffices to eliminate viruses in the groundwater-recharged tertiary effluent. However, when viruses and sand were incubated in the presence of the surfactants sodium dodecyl sulfate, nonyl phenol, dodigen 226, or alkylbenzylsulfonate, the adsorption of the viruses was substantially diminished. Experiments in the presence of nonyl phenol seem to indicate that hydrophobic interactions are involved in the adsorption of viruses to sand. (Murphy-IVI)
W84-03704

DISTRIBUTION FUNCTION OF HEAVY METALS IN RIVER SEDIMENT,
Nippon Inst. of Tech., Saitama. Applied Statistics Lab.
H. Nishida, and M. Miyai.
Bulletin of Environmental Contamination and Toxicology, Vol. 32, No. 2, p 212-219, February, 1984. 2 Fig, 2 Tab, 5 Ref.

Descriptors: *Heavy metals, *Fate of pollutants, *Sediments, Japan, Copper, Chromium, Zinc, Lead, Cadmium, Nickel, Distribution.

Random samples of unpolluted upstream and downstream sediments were obtained at 10 points from the right to left banks of each of 92 rivers in Japan. The upstream sediments were taken at unpolluted places and those downstream were taken about 1 km from the river mouth. The quantities of heavy metals soluble in hydrochloric acid were measured. In order to decide the distribution function of each heavy metal, its AIC was calculated. The AIC is a statistical decision procedure for model fitting. Each heavy metal of river sediment derived from a single source was found to be distributed lognormally. (Baker-IVI)
W84-03707

RESIDUES OF 4-CHLORO-1-(2,4-DICHLOROPHENOXY)-2-METHOXYBENZENE (TRICLOSAN METHYL) IN AQUATIC BIOTA,
Tokyo Metropolitan Research Lab. of Public Health (Japan).
T. Miyazaki, T. Yamagishi, and M. Matsumoto.
Bulletin of Environmental Contamination and Toxicology, Vol. 32, No. 2, p 227-232, February, 1984. 3 Fig, 3 Tab, 8 Ref.

Descriptors: *Fate of pollutants, *Fish, *Organic compounds, Triclosan methyl, Fish, Oysters, Clams, Mussels, Tama River, Tokyo Bay, Japan.

A total of 14 samples (10 fish and four shellfish) was collected at 11 sampling locations in the Tama River and Tokyo Bay (Japan) during September to October 1981. Triclosan methyl was found in 13 of the 14 samples, detected in all freshwater fish, and ranged from 1-38 ppb. Triclosan methyl is a methyl ether deriviative of triclosan, a broad spectrum antibacterial agent used widely in varied products such as deodorant, surgical scrub preparations, and medicated cosmetics. The concentrations in the fish samples increased downstream. Triclosan methyl residue was also found in shellfish taken from Keihinjima along Tokyo Bay with short necked clams having 3 ppb; thin shelled surf clams, 13 ppb; oysters, 13 ppb and blue mussel, 20 ppb. (Baker-IVI)
W84-03709

COOLING WATER SUPPLY DISPOSAL IN COASTAL AQUIFER,
Dames and Moore, Honolulu, HI.
M. R. Fujioka, and A. K. Runchal.
Journal of Energy Engineering (ASCE), Vol. 109, No. 2, p 88-102, June, 1983. 10 Fig, 2 Tab, 9 Ref.

Descriptors: *Cooling water, *Disposal wells, *Coastal aquifer, Coupled fluid flow, Heat transport, Mass transport, Groundwater, Water reuse, Mathematical models, Geohydrology, Permeability coefficient.

The analysis of cooling water supply and thermal effluent disposal within a coastal aquifer requires the solution of the coupled transport equations for groundwater, heat, and mass transfer. A general numerical model for these requirements was applied to assess feasibility of simultaneous cooling water supply and effluent disposal by wells. Hydraulic conductivities were calibrated using groundwater heads and flux data. Existing conditions, a Ghyben-Herzberg lens in dynamic equilibrium, were modeled, and served as initial conditions for subsequent analysis. Various injection and supply well configurations were modeled and feasible configurations were identified. A number of conclusions were developed regarding flow velocities, cross-circulation flow, hydraulic interchange with the adjacent ocean, heat removal mechanisms, effects on the fresh water lens, and ocean bottom heating. (Murphy-IVI)
W84-03713

STUDY OF THE POLLUTION POTENTIAL OF LAND-SPREAD SEPTAGE,
Oregon State Univ. Extension Service, Corvallis.
J. A. Moore, and G.R. Beehler.
Journal of Environmental Health, Vol. 46, No. 4, p 171-175, January/February, 1984. 1 Fig, 1 Tab, 14 Ref.

Descriptors: *Land disposal, *Groundwater pollution, *Septage, Nitrates, Coliforms, Soil properties, Hydraulic loading.

There are two possible health hazards associated with the land spreading of septage: pathogenic and chemical contamination of surface and groundwaters. Seven plots which had not previously been treated with septage were treated with two types of domestic septage application. Four plots, receiving no more than 3,000 gal/day were intermittently loaded receiving 174,000, 169,000, 32,000 and 39,000 gallons of septage during the three year study. This represented a total nitrogen application equivalent to 2,400, 1,100, 630 and 290 lbs N/acre. Spreading nitrogen at a rate of 10,000 lbs/acre or 90 acre inch of septage over an 11 week period resulted in no evidence of penetration of fecal coliform organisms to the shallow (3 m) water table. The nitrate nitrogen increased slightly in one of the four monitoring wells, and all values were below 10 mg/l. Neither slug loading up to 4 gal/sq foot or steady intermittent loadings (up to 3,000 gal per plot/day) of septage harmed the shallow groundwater. Fecal coliform counts and nitrate nitrogen levels show the tremendous treatment capability of the sandy soil. Finer textured soils should provide a better filter and further reduce the movement of organisms and nitrate. The capacity of the soil filter can be exceeded, resulting in contamination of the groundwater. Application rate of septage should be limited depending on the characteristics of the receiver soil, so that hydraulic loading would provide unsaturated flow through the profile, allowing adequate treatment. (Baker-IVI)
W84-03722

VIRUSES IN GROUNDWATER BENEATH SEWAGE IRRIGATED CROPLAND,
Minnesota Univ., St. Paul. Coll. of Veterinary Medicine.
S. M. Goyal, B. H. Keswick, and C. P. Gerba.
Water Research, Vol. 18, No. 3, p 299-302, 1984. 6 Tab, 14 Ref.

Descriptors: *Viruses, *Wastewater irrigation, *Groundwater pollution, Wells, Spray irrigation, Land disposal, Wastewater disposal, Irrigation, Coliforms, Coxsackievirus, Water reuse, Chlorination.

The occurrence of enteric viruses in groundwater and soil was examined beneath three different sites where slow rate sewage irrigation of cropland is practiced. One site was in Lubbock, Texas where a sewage treatment plant supplies 57,000 cu m/day of secondarily treated effluent to a privately owned 3000 acre farm where the effluent is applied by flood or spray irrigation. Location two was in San Angelo, Texas where secondarily treated effluent is applied to a 640 acre farm by flood irrigation. Location three was in Muskegon, Michigan, where sewage at a rate of 105,000 cu m/day is aerated and stored in two 850 acre lagoons. The effluent is then applied to the 11,000 acre farm by 54 center-pivot spray arms at rates of up to 10 cm per week. Enteric viruses were isolated from wells beneath all sites. The lowest frequency of isolation was from wells beneath the one site practicing chlorination before application by spray irrigation. Viruses were detected in wells as deep as 27.5 m. (Baker-IVI)
W84-03731

STUDIES ON VINYL CHLORIDE MIGRATING INTO DRINKING WATER FROM POLYVINYL CHLORIDE PIPE AND REACTION BETWEEN VINYL CHLORIDE AND CHLORINE,
National Inst. of Hygienic Sciences, Tokyo (Japan).
M. Ando, and Y. Sayato.
Water Research, Vol. 18, No. 3, p 315-318, 1984. 9 Fig, 1 Tab, 6 Ref.

Descriptors: *Water pollution sources, *Vinyl chloride, *Pipes, *Drinking water, *Polyvinyl chloride, Pipe liners, Migration, Chemical reactions, Chlorine, Chloroacetaldehyde, Chloroacetic acid, Hydrogen ion concentration, Water conveyance.

Actual conditions under which vinyl chloride monomer (VCM) migrates into water from polyvinyl chloride (PVC) pipes and the reaction of VCM with chlorine in water are considered. In one study method, migration of VCM into water from PVC pipes was examined by sealing water in sections of PVC pipe. In the second method a few pieces of PVC pipe were sealed with water in a serum vial. Migration of VCM into water from PVC pipes could only be detected by using an apparatus that prevented volatilization of VCM and increased the surface area of the pipe wall in contact with the water. The amount of VCM which could undergo action of the chlorine in the water decreased markedly with the age of the pipes and when the pH was lowered. VCM occurred in the water and was converted to chloroacetaldehyde, chloroacetic acid and other compounds through its reaction with chlorine. The amounts of these reactants varied with the pH of the solution. (Baker-IVI)
W84-03733

HEAVY METALS IN THE SURFICIAL SEDIMENTS OF FONTANA LAKE, NORTH CAROLINA,
Clemson Univ., SC. Dept. of Environmental Systems Engineering.
A. R. Abernathy, G. L. Larson, and R. C. Mathews, Jr.
Water Research, Vol. 18, No. 3, p 351-354, 1984. 1 Fig, 2 Tab, 19 Ref.

Descriptors: *Heavy metals, *Lake sediments, *Fontana Lake, *North Carolina, Lakes, Sediments, Zinc, Copper, Mercury, Aluminum, Manganese, Iron, Magnesium, Minerals.

Samples of sediment were collected in the main body of Fontana Lake and near the mouths of its major tributaries. Analyses were conducted for magnesium, iron, aluminum, manganese, zinc, copper, and mercury. While the drainage area of the reservoir is primarily forested and rural without major industrial developments, manganese, copper and zinc were present in concentrations similar to areas receiving industrial pollution. Chemical analyses of pyritic materials in the watershed showed relatively high concentrations of many of the same metals. Therefore, inputs of metal compounds may be expected from lake or reservoir drainage basins with mineralized deposits. Accumulations of these metals in the sediments may pose a biological risk in the future. This may be especially important should the lake or reservoir acidity increase owing to impacts from acid precipitation upon the soft water system. (Baker-IVI)
W84-03738

CONTAMINATION OF AN UNCONFINED SAND AQUIFER BY WASTE PULP LIQUOR: A CASE STUDY,

Waterloo Univ. (Ontario). Dept. of Earth Sciences.
W. D. Robertson, J. F. Barker, Y. LeBeau, and S. Marcoux.
Ground Water, Vol. 22, No. 2, p 191-197, March-April, 1984. 6 Fig, 1 Tab, 5 Ref.

Descriptors: *Groundwater pollution, *Unconfined aquifers, Aquifers, Path of pollutants, Pulp and paper industry, Industrial wastes, Waste disposal, Sulfates, Chlorides, Sodium, Plumes, Lignin, Tannin.

A zone of contaminated groundwater has been identified in an unconfined sand aquifer adjacent to a pit near the town of La Tuque, Quebec into which spent pulp liquor was intermittently discharged from 1970 to 1979. The installation of multilevel piezometers has provided a cost-effective method for three-dimensional mapping and sampling of the plume in the sand. The contaminated groundwater is characterized by elevated concentrations of Na (3,000 mg/l), Cl (590 mg/l), alkalinity (2,700 mg/l), total organic carbon (2,000 mg/l), COD (10,800 mg/l), BOD (2,000 mg/l) tannin and lignin (780 mg/l), and lower sulfate (1 mg/l) compared to groundwater in the area. Contaminants such as Na(+), Cl(-), tannin and lignin appear to migrate at a rate close to the average linear groundwater velocity. Hydrodynamic dispersion has caused vertical and horizontal spreading of the contaminants and significant dilution especially near the leading edge of the plume. Other major contaminants such as sulfates and high pH are substantially attenuated, probably in part by microbially mediated processes. Some organic components also appear to be attenuated, but high concentrations of less biodegradable substances such as tannin and lignin, persist along the flow path. (Baker-IVI)
W84-03763

FATE AND EFFECT OF (14C)FENVALERATE IN A TIDAL MARSH SEDIMENT ECOSYSTEM MODEL,
Maryland Univ., College Park. Dept. of Entomology.
J. A. Caplan, A. R. Isensee, and J. O. Nelson.
Journal of Agricultural and Food Chemistry, Vol. 23, No. 1, p 166-171, January/February, 1984. 7 Fig, 3 Tab, 17 Ref.

Descriptors: *Pesticides, *Fenvalerate, *Tidal marshes, Fate of pollutants, Sediments, Leaching, Microorganisms, Water pollution effects, Salt marshes.

A model salt marsh ecosystem was developed and used to evaluate the fate and effect of a pesticide under simulated salt marsh conditions. Fenvalerate was used as a reference pesticide. Fenvalerate is a pyrethroid insecticide that has great potential for control of a wide range of insect pests in agriculture. Two dosages (0.2 and 1.0 ppm) of C-14 labeled fenvalerate were uniformly applied to the sediment. Additionally, a third treatment (1.0 ppm) was applied to the top centimeter of a 3-cm column to monitor the vertical movement of the compound (plus metabolites). No adverse effects of C-14 fenvalerate on heterotrophic microorganisms were observed after 7 days at any treatment level, as measured by plate counts and substrate degradation assays (starch, cellulose, and protein). The half-lives of C-14 fenvalerate in the 0.2- and 1.0 ppm noncolumn treatments were 6.3 and 8.9 days, respectively. The lower half-life (3.2 days) observed in the 1.0 ppm column treatment was attributed to a higher leaching rate in that treatment. TLC analysis of sediment extracts revealed the presence of three identifiable metabolites in all treatments after 4 days of incubation. (Baker-IVI)
W84-03769

ORIGINS OF SOME ARSENIFEROUS GROUNDWATERS IN NOVA SCOTIA AND NEW BRUNSWICK, CANADA,
National Hydrology Research Inst., Ottawa (Ontario).
D. J. Bottomley.
Journal of Hydrology, Vol. 69, No. 1-4, p 223-257, February, 1984. 16 Fig, 5 Tab, 70 Ref.

Descriptors: *Arsenic, *Groundwater, *Nova Scotia, *New Brunswick, Groundwater pollution, Mine wastes, Gold, Ferric oxyhydroxides, Hydrogeology, Chemical properties, Geochemistry.

The presence of arsenic in drinking-water supplies is a cause for concern since its potential toxicity, mutagenicity and carcinogenicity to man is still poorly understood and very controversial. Arsenic is relatively mobile under a broad range of pH-Eh conditions typical of groundwaters with the result that where arseniferous minerals are present in the subsurface, aresenic contamination of groundwaters has frequently be reported. Arsenic-contaminated groundwaters occur in regions of New Brunswick underlain by the Carboniferous volcanic tuff of the Harvey Formation, and in Nova Scotia where bedrock is comprised of early Paleozoic metasedimentary formations of the Meguma Group. At Harvey, N.B., aresenic is present in dispersed iron oxide aggregations in the tuff, whereas in the Meguma rocks arsenic is concentrated in arsenopyrite commonly present in quartz veins that were once mined for their gold content. The arsenic-contaminated groundwaters range in age from less than 10 yr. to greater than 100,000 yr. and are found both under oxidizing and reducing conditions. While the arsenic contamination in both areas is ultimately attributable to oxidation of arseniferous minerals, geochemical analyses of the aquifer materials in a former gold mining district of Nova Scotia suggest contamination of young groundwater may occur through exchange reactions with 'unsupported' extractable arsenic associated with ferric oxyhydroxides. The source of this extractable arsenic was likely infiltrated runoff that had been in contact with mine waste rock. (Murphy-IVI)
W84-03785

RESIDENCE TIME: APPLICATION TO SMALL BOAT BASINS,
Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
J. van de Kreeke.
Journal of Waterway, Port, Coastal and Ocean Engineering, Vol. 109, No. 4, p 416-428, November, 1983. 4 Fig, 5 Ref.

Descriptors: *Residence time, *Boat basins, Water pollution, Marine environment, Recreation wastes, Boating, Marinas, Water circulation, Mathematical equations, Tidal hydraulics.

To assure that concentrations of pollutants remain below critical levels, the pollutant input has to be small and the rate at which the water in the boat basin is exchanged has to be large. Using a continuous exchange model, analytical expressions for the transit time distribution function and the age distribution function are derived for a basin having a constant volume. The residence time for instantaneous as well as continuous dye injections equals the volume of the basin divided by the rate at which new water is added to the basin. Using the tidal prism model it is shown that the normalized residence time for an instantaneous dye injection is a function of three dimensionless parameters. These parameters are: (1) The average basin volume divided by the volume of new water returning on the flood; (2) the fraction of the flood volume (= tidal prism) that is new water; and (3) the phase of the tide at which the dye is injected. For a continuous dye injection, the normalized residence time is a function of the first two parameters only. Numerical computations show that, to a first approximation, the residence times equal the average basin volume divided by the volume of new water entering during flood with secondary effects introduced by the other parameters. (Murphy-IVI)
W84-03798

CONSERVATIVE BEHAVIOUR OF BORON IN THE TAMAR ESTUARY,
Marine Biological Association of the United Kingdom, Plymouth (England).
For primary bibliographic entry see Field 2L.
W84-03806

LANDFILL LEACHATE MIGRATION THROUGH SHALLOW UNCONFINED AQUIFERS,
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
D. W. Ostendorf, R. R. Noss, and D. O. Lederer.
Water Resources Research, Vol. 20, No. 2, p 291-296, February, 1984. 1 Fig, 4 Tab, 22 Ref.

Descriptors: *Landfills, *Leachates, *Aquifers, Model studies, Transport, Groundwater pollution, Water pollution sources, Kinetics, Adsorption.

The transport of a simple reactive contaminant through a landfill and an initially pure, underlying shallow, one-dimensional unconfined aquifer has been modeled. The aquifer has a plane, sloping bottom with steady hydraulic conditions. Absence of dispersion and downgradient dilution were assumed. The user population and a presumedly constant contaminant loading factor determine the pollution input to the groundwater system. The near field response is modeled as a single linear reservoir whose output comprises the far field source term at the downgradient edge of the landfill. The far field analysis yields a method of characteristics solution valid in the vicinity of the source location with frame speeds modified by recharge, head loss, bottom slope, and linear adsorption, and concentrations reflecting first order reaction kinetics. The near and far field models are calibrated and tested against conservative chloride and first order reactive bicarbonate data at the Babylon, New York landfill with accurate and physically plausible results. (Baker-IVI)
W84-03825

SOLUTE REDISTRIBUTION DURING NORMAL FREEZING,
Iowa Univ., Iowa City.
W. K. S. Leung, and G. R. Carmichael.
Water, Air, and Soil Pollution, Vol. 21, No. 1-4, p 141-150, January, 1984. 8 Fig, 1 Tab, 6 Ref.

Descriptors: *Path of pollutants, *Model studies, *Freezing, *Solutes, Mathematical models, Burton-Slichter film theory, Films, Snowmelt, Ice.

In northern areas where snow precipitation is abundant in winter time, 50 to 80% of the pollutants accumulated in the snowpack are released when the first 30% melts. The very first meltwater may have concentrations 5 times the values found in the bulk. A thorough understanding of snow and ice pack chemistry and melting is necessary to predict the chemical composition and delivery rates of meltwater aquatic systems. An investigation of segregation of solutes and their transport properties in ice layers is reported and techniques for estimating solute redistribution resulting from normal freezing processes are presented. Mathematical models used in metallurgy to describe solute partitioning are applied to solute distribution in ice crystals. The method can be used to estimate distribution coefficients from experimental data. Under the assumptions of this model the solute concentration in the solid is linearly dependent on the solute concentration in the liquid and the distribution coefficient is concentration independent and constant. However, predicted distribution coefficients varied with the fraction frozen. The deviation of experimental results from normal freezing theory is consistent with the Burton-Slichter film theory model. (Baker-IVI)
W84-03831

SULPHATE AND NITRATE RELATED TO ACIDITY IN RAINWATER,
Central Energy Generating Board, Ratcliffe-on-Soar (England). Scientific Services Dept.
A. Martin.
Water, Air, and Soil Pollution, Vol. 21, No. 1-4, p 271-277, January, 1984.

Descriptors: *Acid rain, *Sulfates, *Nitrates, Water pollution sources, Monitoring, Acidity, Sampling, Europe, Hydrogen ion concentration.

Sulfate and nitrate concentrations in rainwater were shown to vary systematically with the acidi-

ties of the samples from certain rural sites from Europe and the U.S. Major differences were found between strong- and weakly-acid rainwaters. The mean non-sea sulfate to H(+) ratios in the weakest acid class correlate significantly with the annual SO2 in air for the 8 sites in Europe whereas those in the strongest acid class do not. The mean ratios of nitrate to H(+) show a similar pattern to the ratios of sulfate to H(+), but the weakly acid values are only about 0.33 as large. Weakly acid samples could modify on standing and therefore special care is needed in attempts to use them to identify sources. Some differences are noted between samples from Europe and from the Northeastern United States, possible due to the differences in the types of collectors used. In terms of possible effects, rainwater sampled by open collectors for the period over which effects may develop, and modifying as they will, might be an adequate simulation of rain on some types of surfaces. Only strong acid cloud and rainwaters, sampled as events (or daily) in ways that minimize changes in the solutions, are likely to be relevant to their initial composition. Weak acid samples, or mixtures of strong and weak acid samples, should only be used for that purpose with the utmost care. (Baker-IVI)
W84-03835

MOVEMENT OF PHORATE UNDER CONSTANT AND VARIABLE SURFACE WATER FLUX IN INITIALLY DRY AND MOIST SOILS,
Haryana Agricultural Univ., Hissar (India). Dept. of Entomology.
G. Singh, I. S. Dahiya, and Z. Singh.
Water, Air, and Soil Pollution, Vol. 21, No. 1-4, p 439-446, January, 1984. 4 Fig, 2 Tab, 16 Ref.

Descriptors: *Insecticides, *Leaching, Phorate, Organic compounds, Soil properties, Soil water, Surface water.

Agricultural chemicals applied to the soil surface are susceptible to transport through the soil profile with the flowing soil water when water infiltration occurs as a consequence of rainfall or irrigation. The distribution of phorate was studied in three texturally different soils under constant and variable surface flux of water. Phorate distribution profiles and leaching curves showed that the insecticide was displaced more efficiently and its concentration peak formed at deeper depth with constant than with variable water flux in sandy loam soils irrespective of initial soil water content. Phorate distribution profiles, however, were independent of the methods of water application in clay soil because of its extremely low permeability. Phorate distribution was considerably dependent on the initial soil water content. The greater the initial soil water content, the greater was the penetration of phorate. (Baker-IVI)
W84-03841

DISSOLVED NITROGEN SUPERSATURATION OF A HEATED EFFLUENT,
Delaware Univ., Newark. School of Life and Health Sciences.
D. A. Neumann, E. L. Melisky, and W. J. Wachter, Jr.
Water, Air, and Soil Pollution, Vol. 22, No. 1-4, p 1-13, January, 1984. 5 Fig, 3 Tab, 17 Ref.

Descriptors: *Dissolved nitrogen, *Supersaturation, *Heated water, *Effluents, Electric powerplants, Nitrogen, Water pollution effects, Cooling water, Water temperature, Thermal pollution, Fishkill, Erie, Pennsylvania.

Electric power generation constitutes one of the largest industrial uses of water in the United States. Presented is an empirical assessment of the dynamics of dissolved gas supersaturation in the effluent of a steam electric generating station in response to observations of mass mortalities among fish overwintering in a heated effluent. Surface water samples were collected from the intake, discharge, and heated plume of a fossil-fueled electric generating station from January 1974 through September 1976. Dissolved N2 concentrations were determined manometrically for each sample and the percent saturation of each was calculated. Intake N2 levels were near saturation throughout the sampling period while discharge N2 values consistently exceeded saturation, often ranging from 110% to 120% saturation. Saturation levels based on N2 analysis and on polarographic measurement O2 did not differ significantly. Discharge saturation levels were predictable from a three variable equation which considered the rise in cooling water temperature (delta T), percent N2 saturation at the intake, and cooling water flow rate. Other parameters associated with cooling system operation were not significantly related to the discharge N2 level. First-order regression analysis indicated that discharge saturation levels could be readily estimated from delta T measurements. Seasonal variation in supersaturation levels at the discharge was related to the interaction of the delta T and the intake temperature. Supersaturation occurred throughout the heated effluent; levels decreased with increasing distance from the discharge. Dissipation of supersaturated conditions in the plume resulted from cooling and was predictable. (Murphy-IVI)
W84-03842

BULK DEPOSITION OF METALS IN TULSA, OKLAHOMA,
Oklahoma State Univ., Stillwater. Dept. of Civil Engineering.
M. B. Tata, and M. H. Bates.
Water, Air, and Soil Pollution, Vol. 22, No. 1, p 15-26, January, 1984. 6 Fig, 3 Tab, 27 Ref.

Descriptors: *Metals, *Deposition, *Arkansas River, *Tulsa, *Oklahoma, *Precipitation, Cadmium, Chromium, Lead, Nickel, Zinc, Heavy metals, Water pollution sources.

A low water dam is being constructed on the Arkansas river near downtown Tulsa, Oklahoma and it is feared that the quiescent pool which will be formed could be a sink for toxic heavy metals. Samples of bulk precipitation (wet and dry fallout) were collected at six sites adjacent to the Arkansas River in Tulsa over an 11 month period and analyzed by flameless atomic absorbtion spectrophotometry for cadmium, nickel, chromium, lead, and zinc. Metal deposition was fairly constant from site to site and appeared to be proportional to the amount of precipitation collected. Zinc was by far the largest contributing metal at 497 mg/sq m/yr, followed by Pb, Cr, Ni and Cd at 25.5, 25.7, 7.02, and 0.95 mg/sq m/yr, respectively. Concentration data vaired greatly over the collection period. The average volume-weighted concentrations in micrograms per liter were CD-2.1, Cr-57.0, Ni-15.6, Pb-56.6, and Zn-1100. (Baker-IVI)
W84-03843

BENZ(A)PYRENE INPUT AND OCCURRENCE IN A MARINE AREA AFFECTED BY REFINERY EFFLUENT,
Marine Pollution Lab., Charlottenlund (Denmark).
K. Jensen.
Water, Air, and Soil Pollution, Vol. 22, No. 1, January, 1984. 3 Fig, 5 Tab, 10 Ref.

Descriptors: *Organic compounds, *Benz(a)pyrene, *Kalundborg Fjord, *Denmark, Oil wastes, Industrial wastes, Water pollution sources, Sediments, Degradation, Advection, Fate of pollutants.

The load of benz(a)pyrene (BaP) in Kalundborg Fjord, a marine coastal area in the vicinity of a town and an oil refinery was estimated. An oil refinery discharges 1,500,000 cu m/yr of wastewater into the inlet. The levels of the compound in refinery effluent, municipal wastewater, urban run-off, rivers, and atmospheric fall-out have been determined. Three major routes are assumed to account for the removal of BaP from the water body of Kalundborg Fjord. These include degeneration in the water, sedimentation and advective water exchange. The major problem to estimating the removal of BaP from the water body is to estimate the standing stock of BaP. The degradation rate is very slow. At one station in the fjord the sedimentation rate of dry matter has been determined at 740 g/sq m/yr. If the BaP content of the sedimentated materials equals the level in the surface sediment at this particular station, 41 micro g/kg, the sedimentation would be 30.3 micro g/sq m/yr. The remaining part of BaP, approximately 1 kg, is removed by advective water transport. (Baker-IVI)
W84-03844

BACTERIAL POLLUTION OF GROUNDWATER: A REVIEW,
Oregon State Univ., Corvallis. Dept. of Agricultural Engineering.
S. R. Crane, and J. A. Moore.
Water, Air, and Soil Pollution, Vol. 22, No. 1, p 67-83, January, 1984. 2 Fig, 4 Tab, 83 Ref.

Descriptors: *Bacteria, *Groundwater pollution, Wastewater Disposal, Wastewater pollution, Reviews, Soil contamination, Soil classification, Soil physical properties, Soil water, Wastewater management, Infiltration.

Contamination of groundwater resources from bacterial laden wastewater and effluents poses a great threat to potability and use of these water sources. Future planning, development and management schemes must consider this topic to avoid costly and sometimes untested corrective actions. Major factors affecting the quantity and velocity at which bacteria are able to migrate through soil can be classified as (1) soil factors including particle size distribution, structure, clay content, pore size distribution and moisture regime, and (2) biological factors responsible for bacterial die-off including pH, temperature, moisture content, and nutrient supply. Past bacterial pollution problems have been shown to be localized and restricted to wells utilizing near-surface waters. The following problem areas exist and must be given special consideration in planning and development: (1) use of septic disposal systems in unsuitable soils; (2) drainage water from wastewater application areas utilizing artificial drainage systems; (3) waste application in areas underlain by fractured crystalline rock or channelized bedrock; and (4) bacterial contamination induced over great distances by groundwater pumping. (Author's abstract)
W84-03845

WATER QUALITY AT AND ADJACENT TO THE SOUTH DADE COUNTY SOLID-WASTE DISPOSAL FACILITY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
D. J. McKenzie.
Available from the Ofss, USGS, Lakewood, CO 80225; Price: $5.25 in paper copy, $3.50 in microfiche. USGS Water-Resources Investigations Report 83-4003, 1983. 37 p, 8 Fig, 8 Tab, 23 Ref.

Descriptors: *Water quality, Landfill, Leachate, *Limestone aquifer, Organic decomposition, Solid waste, *Biscayne aquifer, Biscayne Bay, *Florida, *Nitrification, Chloride indicator, Ammonia tracer, Ammonia migration, Alkalinity.

A water-quality reconnaissance was conducted at the south Dade County solid-waste landfill near Goulds, Florida, from December 1977 through August 1978. The landfill is located directly on the unconfined Biscayne aquifer, which, in the study area, is affected by saltwater intrusion. Water samples collected from six monitor well sites at two depths and four surface-water sites were analyzed to determine the chemical, physical, and biological conditions of the ground water and surface water of the study area. Results indicated that water quality beneath the landfill was highly variable with location and depth. Leachate was generally more evident in the shallow wells and during the dry-season sampling, but was greatly diluted and dispersed in the deep wells and during the wet season. High concentrations of contaminants were generated primarily in areas of the landfill with the most recent waste deposits. Chloride (limited to the shallow wells and the dry season), alkalinity, ammonia, iron, manganese, lead, phosphorus, and organic nitrogen indicate leachate contamination of the aquifer. Water-quality characteristics in the

surface waters were generally only slightly above backgrcund levels. (USGS)
W84-03846

HYDROLOGIC INFORMATION FOR LAND-USE PLANNING, BADGER ROAD AREA, FAIRBANKS, ALASKA,
Geological Survey, Anchorage, AK. Water Resources Div.
A. P. Krumhardt.
Available from the Ofss, USGS, Lakewood, CO 80225, Price: $2.25 in paper copy, $3.50 in microfiche. USGS Water-Resources Investigations Report 82-4087, 1982. 14 p, 5 Fig, 3 Tab, 8 Ref.

Descriptors: Public health, Arsenic, Nitrate, Iron, Hardness, Water table, Groundwater movement, Water-level fluctuations, Fairbanks, *Alaska, Groundwater, Water wells, Water quality, Water levels.

The relatively flat Badger Road area near Fairbanks occupies part of the alluvial plain of the Chena and Tanana Rivers and is underlain by scattered areas of permafrost. The water table of the high-transmissivity aquifer that underlies the area is generally shallower than 15 feet, fluctuates seasonally about 2 feet, and slopes northwesterly, the direction of ground-water flow. Private domestic-supply wells obtain water from the upper part of the aquifer. Septic systems used to dispose of waste water are installed at or only slightly above the water table in the same aquifer. Analyses of samples from 16 observation wells in undeveloped parts of the study area and from 33 domestic wells indicated that water quality has not been significantly degraded by on-site waste disposal. Three samples had detectable but minor contamination by fecal coliform bacteria. Anomalous values of chloride and ammonia in one third of the domestic wells may indicate incipient degradation of ground-water quality by septic-tank effluent. (USGS)
W84-03852

POTENTIAL EFFECTS OF SURFACE COAL MINING ON THE HYDROLOGY OF THE GREENLEAF-MILLER AREA, ASHLAND, COAL FIELD, SOUTHEASTERN MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 4C.
W84-03853

GROUND-WATER CONTAMINATION AT WURTSMITH AIR FORCE BASE, MICHIGAN,
Geological Survey, Lansing, MI. Water Resources Div.
J. R. Stark, T. R. Cummings, and F. R. Twenter.
Available from the Ofss, USGS, Lakewood, CO 80225, Price: $16.50 in paper copy, $4.00 in microfiche. USGS Water-Resources Investigations Report 82-4002, 1983. 93 p, 44 Fig, 4 Tab, 22 Ref.

Descriptors: *Hydrogeology, *Glacial drift, *Groundwater, Aquifers, Water supply, Groundwater movement, Water pollution, *Path of pollutants, Organic compounds, Wurtsmith Air Force Base, Iosco County, *Michigan.

A sand and gravel aquifer about 65 feet thick underlies Wurtsmith Air Force Base in northeastern lower Michigan. The water table ranges in depth from 10 feet to 25 feet below land surface. Mathematical models indicate that ground-water flow ranges from 0.8 feet per day in the eastern part of the Base to 0.3 feet per day in the western part. Trichlorethylene leaked from a buried storage tank in the southeastern part of the Base and moved northeastward in a plume, contaminating Base water-supply wells. Concentrations exceed 1,000 micrograms per liter in the most highly contaminated part of the plume. Purge pumping removed some of the trichloroethylene and seems to have arrested its eastward movement. Pumping of additional purge wells could increase the rate of removal. (USGS)
W84-03859

FATE AND EFFECTS OF ATRAZINE IN SMALL AQUATIC MICROCOSMS,
Environmental Research Lab., Athens, GA.
For primary bibliographic entry see Field 5C.
W84-03878

POLLUTION STUDIES ON NIGERIAN RIVERS: THE ONSET OF LEAD POLLUTION OF SURFACE WATERS IN IBADAN,
Ibadan Univ. (Nigeria). Dept. of Chemistry.
C. Mombeshora, O. Osibanjo, and S. O. Ajayi.
Environment International, Vol. 9, No. 2, p 81-84, 1983. 4 Tab, 7 Ref.

Descriptors: *Nigeria, *Ibadan, *Lead, Water pollution, Agodi Lake, Oba Lake, Ogunpa Stream, Ona River, Lake of the International Institute of Tropical Agriculture, Traffic density.

Lead levels in the waters and sediments of the lake of the International Institute of Tropical Agriculture, Agodi Lake, Oba Lake, at three stations on Ogunpa stream, and at three stations on Ona River were measured from October 1977 to June 1978, using the combined APDC-MIBK-flame atomic absorption spectrophotometry technique. The lead levels recorded ranged from 0.2 to 46 microg/L for the aqueous phases; however, the levels in the sediments were much higher, ranging from about 18 to 85 mg/kg (dry weights). Although there is nothing alarming about these levels, the levels of lead in water bodies located in areas with high traffic density were consistently higher than levels for comparable waters in low traffic density areas. Similarly, lead levels were significantly higher in the fresh sediments of water bodies in areas with high traffic density, clearly indicating the onset of lead pollution for those high traffic density areas. (Author's abstract)
W84-03886

OIL POLLUTION STUDIES IN THE NILE RIVER. 1. SURVEY OF OIL AND GREASE IN NILE WATER,
National Research Centre, Cairo (Egypt). Water Pollution Control Lab.
A. S. Moursy.
Environment International, Vol. 9, No. 2, p 107-111, 1983. 1 Fig, 4 Tab, 14 Ref.

Descriptors: *Oil pollution, *Ships, *Nile River, *Egypt, Seasonal variations, Vaporization, Water quality control, Water analysis, Powerplants, Lake Nasser, Harbors.

A survey of oil and grease along the Nile River indicated the presence of variable concentrations of these pollutants. Five segments were identified along the Nile River: the Aswan, Assiut, Cairo, Demietta and Rossetta segments. Some stations along the Nile are more polluted than others. These are located mostly at Lake Nasser Port (Aswan segment); oil distribution centers and ship waiting areas (Assiut segment); boat docks, a ship yard, and an electric power station (Cairo segment); and at factory areas (Rossetta segment). The level of oil and grease decreased significantly when moving downstream. The dilution effects result in a lower level of the pollutants in these waters. Furthermore, various chemical, physical, and biological processes that are known to degrade or destroy oil in water undoubtedly contributed to the general decrease in the pollutant concentrations observed. The level of oil and grease along the river was also lower in summer than in winter and spring which may be attributed to the decrease of activities and increase of vaporization processes. (Baker-IVI)
W84-03888

ASSESSMENT OF EL-SALAAM UNDERGROUND WATER FOR POULTRY USE,
National Research Centre, Cairo (Egypt). Water Pollution Control Lab.
H. T. El-Zanfaly, M. R. Lasheen, M. M. El-Abagy, S. A. El-Hawaary, and M. I. Badawy.
Environment International, Vol. 9, No. 4, p 313-317, 1983. 1 Fig, 2 Tab, 23 Ref.

Descriptors: *Water quality, *Bacteria, *Groundwater, *Egypt, El-Salaam, Wells, Water pollution sources, Fecal coliforms, Acidity, Sulfates, Alkalinity, Coliforms, Pesticides.

Water quality was investigated in 13 wells in El-Salaam, near Cairo. The wells were dug specifically to provide water for a company specializing in broiler poultry production. The water was analyzed for the following bacteriological parameters: total bacterial counts, total coliforms, fecal coliforms, fecal streptococci, aerobic spore formers, and total counts for Clostridium per 100 mL. Chemical parameters such as pH, sulfate, alkalinity, hardness, and pesticides indicate that the water is unacceptable for poultry production. Bacteriological testing revealed the same conclusion. Wastewater in an open drain is entering the groundwater. This wastewater contains tremendous concentrations of untreated discharges and represents a significant source of water pollution. (Baker-IVI)
W84-03893

INTERACTIONS BETWEEN DISSOLVED AND SOLID METAL SPECIES IN INLAND WATERS (WECHSELWIRKUNGEN ZWISCHEN GELOSTEN UND FESTEN METALLSPEZIES IN BINNENGEWASSERN),
Technische Univ., Hamburg (Germany, F.R.). Arbeitsbereich Umweltschutztechnik.
U. Forstner.
Fresenius Zeitschrift fur Analytische Chemie, No. 3-4, p 359-360, 1984. 20 Ref.

Descriptors: *Heavy metals, *Inland waters, Hydrologic properties, Chemical properties, Hydrologic cycle, Sediments, Particle size.

Intense industrialization in the Federal Republic of Germany has led to high concentrations of metals. In particular toxic levels of Hg is of high concern. Heavy metal interactions don't always form agglomerations in water but in the case where there is intense quantities of heavy metals a situation can occur where these metals coalesce. Heavy metal sorption reactions on mineral substrates like FeOOH, SiO2 or Al2O3 have sorption in water with 1-1.5 pH from 0 to 100%. The combination of heavy metals and extensive high pH in fresh water increases the potential for agglomeration of the heavy metals with sediment load. Particle size also dictates the potential for mineralization. (Murphy-IVI)
W84-03902

STUDIES ON SEDIMENTS OF THE UPPER AREA OF THE RIVER LAHN: DETERMINATION OF MERCURY AND EVALUATION OF THE RESULTS BY FACTOR ANALYSIS, (UNTERSUCHUNGEN AN SEDIMENTEN AUS DEM BEREICH DER OBEREN LAHN: QUECKSILBER-BESTIMMUNG UND FAKTORENANALYTISCHE AUSWERTUNG),
Marburg Univ. (Germany, F.R.). Fachbereich Chemie.
W. Spickermann, and G. Stork.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 317, No. 3-4, p 361-365, 1984. 2 Fig, 3 Tab, 6 Ref.

Descriptors: *Sediments, *Mercury, Factor analysis, Ion exchange, Lahn River, Marburg, Federal Republic of Germany, Organic compounds.

A study was made on the mercury contents of sediments from the river Lahn and three tributary rivers in the area of Marburg. The contents of carbon and the weight percentage of the grain size fraction < 63 microm were determined. The degrees of contamination were compared and the effect of the input of a purification plant was examined. The sediments of the Lahn, which do not belong to the direct area of influence of a purification plant, as well as the sediments of the three tributary rivers are only weakly contaminated. Factor analysis was applied to achieve a data reduction. It suggests that the bonding of mercury to the sediments is caused mainly by organic substances. Adsorption or ion-exchange are of minor importance. (Murphy-IVI)
W84-03903

SURFACE RUNOFF WATER QUALITY COMPARISONS BETWEEN UNIMPROVED PASTURE AND WOODLAND,

Science and Education Administration, Coshocton, OH. North Appalachian Experimental Watershed.
L. B. Owens, W. M. Edwards, and R. W. Van Keuren.

Journal of Environmental Quality, Vol. 12, No. 4, p 518-522, 1983. 2 Fig, 5 Tab, 23 Ref. EPA grant R-804631.

Descriptors: *Surface runoff, *Water quality, Comparison studies, Pastures, Woodlands, Chemical properties, Sediment transport, Organic compounds, Input-output analysis.

The influence of pasturing on surface runoff water quality was studied on a 26-ha, unimproved pasture watershed in eastcentral Ohio. Data were collected for 2 y with no cattle in the pasture and for 3 y with summer grazing by a 17-cow beef cattle herd. Because of springs and seep areas in the pasture, a small stream (accessible to the cattle) in the watershed flowed permanently. Samples of storm runoff were collected with a rotating vane sampler. The concentrations of most of the measured chemical parameters (NO3-N, mineral N, organic N, total P, K, Ca, Mg, Na, S, Cl, HCO3, total organic C, salts) in the storm discharge water were low and changed very little as a result of grazing. The weighted annual NO3-N concentrations for the ungrazed period and grazed period were 0.5 and 0.7 mg/L, respectively. A 17.7-ha, wooded watershed that contained no pastured areas and received no agricultural chemical limits, had concentrations of chemical parameters in surface discharge that were greater than or equal to those from the unimproved pasture during the grazing period. Nutrient transport during storm runoff from the unimproved pasture was greater during the 3-y period with summer grazing than during the 2-y, ungrazed period. This largely resulted from increased precipitation and subsequent increased surface runoff during the 3-y period. The transport levels from the pasture during the 3-y period were similar to or less than the transport levels from the wooded watershed during the same period. The increase in sediment transport from the pastured areas was more than could be attributed solely to the increased surface runoff. (Author's abstract)
W84-03930

AZINPHOSMETHYL AND FENVALERATE RUNOFF LOSS FROM A SUGARCANE-INSECT IPM SYSTEM,

Louisiana Agricultural Experiment Station, Baton Rouge.
S. Smith, T. E. Reagan, J. L. Flynn, and G. H. Willis.

Journal of Environmental Quality, Vol. 12, No. 4, p 534-537, 1983. 2 Tab, 19 Ref.

Descriptors: *Azinphosmethyl, *Fenvalerate, *Runoff loss, Runoff volume, Sugarcane, Insecticides, Aquatic habitats, Ecological effects.

Agriculture in the lower Mississippi River Valley greatly depends on the use of pesticides to help control severe weed and insect pest infestations and increase crop yields. Azinphosmethyl and fenvalerate were applied to sugarcane (Saccharum officinarum L.) runoff plots at rates of 0.84 and 0.22 kg/ha, respectively, 4 times each year in 1980 and 1981 as part of an insect integrated pest management (IPM) system research evaluation for season-long control of the primary sugar-cane insect pest, the sugarcane borer. Runoff samples (water + sediment) were collected within 8 ha after each storm and analyzed by gas chromatography. In 1980, runoff losses of azinphosmethyl and fenvalerate were 0.08 and 0.02%, respectively, of the amount applied. Runoff in 1981 was about twice that in 1980, partially accounting for larger insecticide runoff losses measured, 0.55 and 0.56% of that applied for azinphosmethyl and fenvalerate, respectively. The larger 1981 losses also were attributed to shorter time intervals between insecticide applications and runoff events. Azinphosmethyl concentrations in runoff do not appear to be harmful to surrounding aquatic habitats, whereas fenvalerate concentrations might present problems, particularly if applied at 0.22 kg/ha rates. (Murphy-IVI)
W84-03931

NUTRIENT CYCLING IN AN AGRICULTURAL WATERSHED: I. PHREATIC MOVEMENT,

Agricultural Research Service, Tifton, GA. Southeast Watershed Research Center.
R. R. Lowrance, R. L. Todd, and L. E. Asmussen.

Journal of Environmental Quality, Vol. 13, No. 1, p 22-27, 1984. 3 Fig, 3 Tab, 18 Ref. NSF grants DEB 78-10841 and DEB 82-07210.

Descriptors: *Cycling nutrients, *Agricultural watershed, *Groundwater movement, Runoff, Subsurface runoff, Riparian ecosystem, Riparian vegetation, Nitrate, Phosphorus, Calcium, Magnesium, Potasium, Chloride, Sulfate, Sinks, Nutrient removal, Biological filters.

Much of the runoff from agricultural fields in the southeastern Coastal Plain is carried to a stream channel system in a shallow phreatic aquifer. This subsurface runoff often passes through a band of riparian forest before becoming streamflow. It is hypothesized that the riparian ecosystem acts as a nutrient sink and reduces the concentrations and loads of nutrients in the shallow aquifer before the nutrients reach the stream channel. Concentrations and loads (kg/sq m) of NO3-N, NH4-N, organic N, dissolved molydate-reactive P, total P, Ca, Mg, K, Cl, and SO4-S were measured in shallow phreatic wells at 37 locations on an agricultural watershed near Tifton, Ga. Total water volume moving off the watershed in subsurface flow was < 1% of streamflow with corresponding small amounts of nutrients. Nitrate-N, Ca, and Mg had significantly higher concentrations in field wells than in forest or streamside wells. Concentrations of Cl were not reduced as water moved from field to forest. Processes within the riparian zone apparently converted primarily inorganic N from fields (76% NO3-N, 6% NH4-N, 18% organic N) into primarily organic N in streamside wells (10% NO3-N, 14% NH4-N, and 76% organic N). Concentration differences between field and forest wells indicated the riparian forest's ability to act as a sink for NO3-N, Ca, Mg, K, and SO4-S. Due to their role as nutrient sinks, riparian forests are important in maintaining stream water quality on agricultural watersheds. (Author's abstract)
W84-03935

ATMOSPHERIC DEPOSITION AND ROOF-CATCHMENT CISTERN WATER QUALITY,

Pennsylvania State Univ., University Park. School of Forest Resources.
E. S. Young, Jr., and W. E. Sharpe.

Journal of Environmental Quality, Vol. 13, No. 1, p 38-43, 1984. 1 Fig, 4 Tab, 16 Ref.

Descriptors: *Roof-catchment cistern, *Water quality, Air pollution, Water pollution sources, Acid rain, Heavy metals, Water quality standards, Lead, Copper, Cadmium, Toxic metals, Clarion county, Indiana county, Pennsylvania.

Roof-catchment cistern systems consist mainly of a roof that functions as an impervious catchment for collecting precipitation and a storage tank, or cistern. The water is pumped from the cistern through a system of pipes to points of use within the house. The water quality in 40 roof-catchment cistern systems in rural Clarion and Indiana Counties, Pa. was studied to determine the impact of atmospheric deposition. Roof-catchment cisterns are open to atmospheric contaminants such as the toxic metals Pb and Cd, and corrosive acid components present in acid precipitation. Bulk precipitation samples failed to meet the drinking water standard for Pb on several occasions and were consistently quite corrosive. Mean Pb, Cd, and Cu concentrations were well below drinking water limits for all cistern water samples. Cistern water was corrosive in all but a few cases, as indicated by the Langelier saturation index, although not as corrosive as the bulk precipitation due to the dissolution of CaCO, from cistern walls and floors. Vinyl-lined cisterns contained water nearly as corrosive as the incoming precipitation. Seventy percent of the systems on one or more occasions exhibited cistern bottom sediment/water Pb or Cd concentrations that exceeded the drinking water limits. This indicated that metals deposited on roof catchments were accumulating at the bottom of the cisterns. Standing tap water samples exhibited high Pb and Cu concentrations. Nine of the forty systems studied produced standing tap water Pb concentrations that averaged above the drinking water standard. The mean Pb, Cd, and Cu concentrations of running tap water samples all fell below the drinking water standards. Atmospheric deposition of Pb and its infusion into tap water as a corrosion product pose a significant health threat to users of roof-catchment cistern systems in western Pennsylvania. (Murphy-IVI)
W84-03936

DISSIPATION OF PICLORAM IN STORM RUNOFF,

Agricultural Research Service, Temple, TX.
H. S. Mayeux, Jr., C. W. Richardson, R. W. Bovey, E. Burnett, and M. G. Merkle.

Journal of Environmental Quality, Vol. 13, No. 1, p 44-49, 1984. 5 Fig, 3 Tab, 19 Ref.

Descriptors: *Picloram, *Storm runoff, Nonpoint pollution sources, Herbicides, Watersheds, Riesel, Texas.

Picloram is currently used to control woody plants and herbacious weeds on rangelands. Its effectiveness is partially attributed to its greater persistence, compared with other herbicides, a characteristic which limits its use on cropped land. The extent of progressive decrease in concentration of the herbicide picloram (4-amino-3,5,6-trichloropicolinic acid) in intermittent streamflow was determined during runoff-producing storms. Maximum concentrations of picloram were 48 and 250 mg/cu m in initial runoff water leaving a sprayed 8-ha area in 1978 and 1979. Concentration decreased with distance from the treated area in proportion to the size of adjacent, untreated watershed subunits, which contributed runoff water to streamflow. Picloram concentrations usually decreased with each successive runoff event; an exception occurred when unusually large quantities of runoff (8.7 cm) diluted concentrations to levels less than those observed in the succeeding event (1.4 cm runoff). About 6% of the applied picloram left the treated area during a period of 1 month when conditions were especially conducive to transport of the herbicide in surface runoff water. Rapid dilution of picloram was observed after direct introduction of the herbicide near the upper end of a larger stream during rising stage of flow. Maximum concentrations at 90, 1170, and 5400 m downstream from the point of introduction of 1270 g of picloram were 13 720, 470, and 5 mg/cu m, respectively. The calculated quantity of picloram which was detected at the 5400-m sampling point in streamflow was only 0.13% of that introduced. Mixing of water during streamflow and additions of uncontaminated water along the channel apparently reduced picloram concentration to below that detectable by gas chromatography. (Murphy-IVI)
W84-03937

ALGAL AVAILABILITY OF PHOSPHORUS IN SUSPENDED STREAM SEDIMENTS OF VARYING PARTICLE SIZE,

Purdue Univ., Lafayette, IN. Dept. of Agronomy.
R. A. Dorich, D. W. Nelson, and L. E. Sommers.

Journal of Environmental Quality, Vol. 13, No. 1, p 82-86, 1984. 4 Tab, 23 Ref. EPA grant G00533501.

Descriptors: *Algae, *Phosphorus, *Streams, *Suspended sediments, *Particle size, Agricultural watersheds, Inorganic phosphorus, Eutrophication, Bioassay, Algal growth.

Phosphorus limits algal growth in many aquatic systems and inputs of P into such systems have caused algal blooms and associated water quality problems. The availability of sediment P to algae was evaluated in several water stable aggregate-size fractions of suspended stream sediments collected from an agricultural watershed in northeastern Indiana. Sediments were collected during a

storm event, separated into the < 2, 2 to 20, 20 to 53, 53 to 212, and > 212 microm size fractions, sterilized by gamma irradiation, and incubated for 2 weeks with algae. Algal-available P (Paa) was determined by measuring decreases in the NaOH- and HCl-extractable inorganic P (Pi) fractions in sediment during the incubation period. The initial concentrations of P in the NaOH- and HCl-extractable Pi fractions were not related to aggregate size. All aggregate-size fractions had similar Paa concentrations. Nearly equal proportions of sediment Pi (avg 79%) and total P (avg 43%) in aggregate fractions were available to algae, possibly resulting from the similar distribution of primary particle sizes in all aggregate-size fractions. More than 93% of Paa originated in the NaOH-extractable P fraction. Samples that were affected by septic effluents tended to be higher in certain sediment P parameters (e.g., NaOH-extractable Pi, total Pi, total P, and Paa concentrations) than samples containing suspended sediment derived from cropland. This study suggests that runoff models may not need to account for the detachment and transport of aggregate-size classes to predict the movement of algal-available P from cropland to surface waters. (Murphy-IVI)
W84-03939

CYANAZINE LOSSES IN RUNOFF FROM NO-TILLAGE CORN IN 'LIVING' AND DEAD MULCHES VS. UNMULCHED, CONVENTIONAL TILLAGE,
Pennsylvania State Univ., University Park.
For primary bibliographic entry see Field 2E.
W84-03941

FACTORS AFFECTING PHOSPHORUS LOSSES FROM CULTIVATED ORGANIC SOILS,
North Carolina State Univ. at Raleigh.
C. Cogger, and J. M. Duxbury.
Journal of Environmental Quality, Vol. 13, No. 1, p 111-114, 1984. 4 Fig, 4 Tab, 22 Ref.

Descriptors: *Phosphorus, *Soil organic matter, Leaching, Water quality, Soil horizons, Aluminum, Iron, Fertilization, Nonpoint pollution sources, Phosphorus absorption, Fertilization, Histosols, New York.

Organic soils play an important role in agricultural production, but their potential as nonpoint sources of pollution through nutrient leaching is also important. Leaching losses of P from organic soils can have a marked effect on water quality. Factors affecting leaching loss of P from cultivated organic soils in western New York State (Carlisle and Palms series) and ways to reduce these losses were investigated. The behavior of P in organic soils from eight sites with annual leaching losses ranging from < 1 to > 30 kg/ha/y was compared. Inorganic, organic, and total P; P extracted by soil test procedures; percent mineral matter; depth of organic horizons; leaching and adsorption of P; release of P during incubation; and total extractable Al and Fe were compared. Phosphorus balance was estimated using field and laboratory data, and cropping and fertilization history. Aluminum, iron and adsorption equilibria were the best predictors of field leaching losses from these soils. While P loss from these soils is controlled by adsorption reactions, the best way to reduce the loss is through fertilizer management. (Murphy-IVI)
W84-03942

ATRAZINE AND SIMAZINE MOVEMENT TO WYE RIVER ESTUARY,
Agricultural Research Service, Beltsville, MD. Soil Nitrogen and Environmental Chemistry Lab.
D. E. Glotfelty, A. W. Taylor, A. R. Isensee, J. Jersey, and S. Glenn.
Journal of Environmental Quality, Vol. 13, No. 1, p 115-121, 1984. 5 Fig, 3 Tab, 29 Ref.

Descriptors: *Atrazine, *Simazine, *Wye River, *Estuaries, Runoff, Agricultural runoff, Agricultural watersheds, Herbicides, Water pollution sources, Fate of pollutants, Chesapeake Bay.

The Wye River, a tributary of Chesapeake Bay, is a shallow, well-mixed estuary surrounded by an agricultural watershed, a large portion of which is planted in corn (Zea mays L.). A 3-y study of the movement of atrazine (2-chloro-4-ethylamino-6-isopropylamino-s-triazine) and simazine (2-chloro-4,6-bis (ethylamino)-s-triazine) showed that the total amount of herbicide reaching the estuary depended upon the quality applied in the watershed and the timing of runoff with respect to application dates. In a year in which significant runoff occurred within 2 weeks of application, 2 to 3% of the atrazine moved to the estuary. In other years with less runoff, or runoff delayed longer after application, much smaller quantities reached the estuary. Simazine loading was one-tenth that of atrazine. Once in the estuary, atrazine and simazine remained in solution, diluted in a conservative manner with estuarine water, and dissipated with a 10- to 30- d half-life. The maximum measured concentration of atrazine was near 15 microg/L but average concentration at peak loading was < 3 microg/L. Thus, although the Wye River has a high percentage of watershed land planted to corn, herbicide concentrations rarely approached those producing minor effects on submerged aquatic vegetation. (Author's abstract)
W84-03943

PASTURE RUNOFF WATER QUALITY FROM APPLICATION OF INORGANIC AND ORGANIC NITROGEN SOURCES,
Clemson Univ., SC. Dept. of Agricultural Engineering.
R. V. McLeod, and R. O. Hegg.
Journal of Environmental Quality, Vol. 13, No. 1, p 122-126, 1984. 7 Fig, 4 Tab, 12 Ref.

Descriptors: *Agricultural runoff, *Water quality, *Nitrogen, Nitrogen compounds, Water pollution sources, Fertilization, Waste disposal, Municipal wastewater, Manure, Water pollution, Fertilizer, Ammonium nitrate.

After an organic waste has been applied to a soil, some of the waste may be transported by rainfall runoff, snowmelt, or irrigation runoff into surface waters. Surface runoff water quality from a fescue pasture receiving surface application of organic wastes and commercial fertilizer was evaluated at Clemson University (Clemson, S.C.). Dairy manure, poultry manure, and municipal sludge were the organic wastes used in this experiment. Ammonium nitrate was the commercial fertilizer. The organic wastes and commercial fertilizer were applied at the rate of 112 kg N/ha to eight plots during four different periods. Due to an extremely dry year, runoff events were produced by irrigation. The runoff water was collected and samples were analyzed for pH, total P, total suspended solids, total Kjeldahl N, NH4-N, NO3-N, and chemical oxygen demand. The nutrient concentrations in surface runoff were more dependent on the number of rainfalls since application of the fertilizer than on the quantity of rainfall or runoff. The concentrations of potential pollutants from surface-applied organic wastes or commercial fertilizer were reduced by between 80 and 55% after two runoff events. The NO3-N concentration in the surface runoff from the plots receiving the commercial fertilizer exceeded the permissible public water supply standard during the first runoff event. The overall nutrient loss in the runoff was found to be minimal (< 4% of total Kjeldahl N and chemical oxygen demand and < 2.5% of total P). (Murphy-IVI)
W84-03944

BRYOZOANS-POSSIBLE INDICATORS OF ENVIRONMENTAL QUALITY IN BEAR CREEK, MISSISSIPPI,
Science and Education Administration, Oxford, MS. Sedimentation Lab.
C. M. Cooper, and J. W. Burris.
Journal of Environmental Quality, Vol. 13, No. 1, p 127-130, 1984. 1 Fig, 1 Tab, 13 Ref.

Descriptors: *Bryozoans, *Bioindicators, *Bear Creek, *Mississippi, Aquatic ecosystem, Agricultural watersheds, Water quality, Suspended sediments, Sedimentation rates, Habitat, Water pollution effects, Hydrogen ion concentration.

Bryozoans do not indicate pollution by their presence, but some species have been considered pollution indicators by their absence. Collections of samples of water and substrate materials from lakes and stream sections of Bear Creek, Miss., were studied to determine the species of Bryozoa present in different habitats of an aquatic ecosystem with an intensively cultivated flatland watershed (440 km2). Bear Creek (83 km long), a tributary of the Yazoo River in the Mississippi River alluvial delta, is actually a series of six riverine lakes connected by a sluggishly flowing stream. The watershed also includes several other oxbow lakes connected to the stream only during periods of high discharge. Water quality as characterized by total and suspended sediments, deposited sediments, pH, and coliforms deteriorated in a downstream direction. Four species of the sessile colonial invertebrate were indigenous to the three lakes in the system having the lowest total solids, sedimentation rates, and pH. These included Plumatella fruticosa (Allman), Lophopus crystallinus (Pallas), Fredericella sultana (Blumenbach), and Pectinatella magnifica (Leidy). Absence of bryozoans, especially environmentally sensitive Pectinatella magnifica, in downstream areas correlated with degradation of downstream habitat and increased total solids. Selective habitation of these invertebrates in the Bear Creek stream system indicates the possible use of these organisms as environmental indicators of habitat quality. (Murphy-IVI)
W84-03945

DISSOLVED MINERAL SALTS DERIVED FROM MANCOS SHALE,
Kentucky Agricultural Experiment Station, Lexington. Dept. of Agronomy.
V. P. Evangelou, L. D. Whittig, and K. K. Tanji.
Journal of Environmental Quality, Vol. 13, No. 1, p 146-150, 1984. 1 Fig, 4 Tab, 9 Ref. OWRT project B-201-CAL, WRC project UCAL-WRC-W-582; OWRT grant P.L. 95-467.

Descriptors: *Mancos Shale, *Salinity, Gypsum, Alkaline earth carbonates, Mica, Kaolin, Smectite, Mica-vermiculite, Water pollution sources, Fate of pollutants, Cation exchange, Colorado River basin.

The Mancos shale, a sedimentary Upper Cretaceous marine formation exposed over extensive areas in the Upper Colorado River Basin, is recognized as a major contributor to the dissolved mineral salt load in the Colorado River system. It contains gypsum and alkaline earth carbonates, and its clay mineralogy is mica, kaolin, smectite, and interstratified mica-vermiculite. Selected surface samples of partially weathered Mancos shale were also found to contain from 281 to 345 g/kg clay (< 2 microm diam) and to exhibit cation exchange capacities (CEC) ranging from 13.25 to 19.96 cmol/kg. Water suspension extracts from partially weathered shale (1:5 and 1:10 shale/water ratios) were saturated with respect to gypsum (electrical conductivity (EC) values up to 3.16 dS/m and soluble Ca and SO4 up to 25.90 and 40.95 mmol/ + or - L, respectively). Additional Na, K, and Mg released by water indicated sources of soluble ions other than gypsum. Water extracts from unweathered shale yielded much higher quantities of Na (and higher Mg in most cases) than did comparable extracts from partially weathered shale. Barium chloride released larger quantities of Mg from both partially weathered and unweathered shale and large quantities of Na from unweathered shale than did water at comparable dilutions. The data substantiate the important role of the cation exchange complex in retention and release of soluble ions in Mancos shale. Sodium and magnesium were preferentially adsorbed by phyllosilicates within the shale and Ca was precipitated as calcite and gypsum following emergence after deposition in the Cretaceous sea. This cycle is essentially reversed in the present environment. Dispersed gypsum and alkaline earth carbonates provide soluble Ca to displace adsorbed Na and Mg that add to the dissolved mineral salt load of the Colorado River system. (Author's abstract)
W84-03947

SHALLOW GROUNDWATER QUALITY BENEATH AN INTENSIVE MULTIPLE-CROPPING SYSTEM USING CENTER PIVOT IRRIGATION,
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Center.
R. K. Hubbard, L. E. Asmussen, and H. D. Allison.
Journal of Environmental Quality, Vol. 13, No. 1, p 156-161, 1984. 5 Fig, 2 Tab, 9 Ref.

Descriptors: *Shallow groundwater, *Water quality, *Multiple-cropping, Center pivot irrigation, Nitrogen compounds, Irrigation design, Irrigation effects, Groundwater pollution, Groundwater level, Soil horizons, Nitrate, Nitrogen, Leaching, Sandy soils, Coastal plain, Sprinkler irrigation, Fertilization, Groundwater flow.

Substantial increases in groundwater NO3-N are of particular concern on intensively cropped irrigated sandy soils. A study was conducted to compare shallow groundwater NO3-N concentrations under intensive multiple cropping systems with those from under nearby nonagricultural sites. The intensive multiple cropping systems involved center pivot irrigation and sprinkler-applied fertilizer. The study was conducted on a sandy Coastal Plain soil by weekly measurement and sampling of observation wells located under a center pivot area and at two forest sites. Nitrate-N concentrations under the center pivot area ranged from < 1 mg/L to about 133 mg/L, with a mean of 20 mg/L (n = 360, SD = 19.5). In contrast, samples from the forest sites had NO3-N concentrations ranging from < 0.1 mg/L to just over 1 mg/L. Mean NO3-N concentrations under the center pivot area were found to vary seasonally according to cropping and hydrologic patterns such that the mean values for March-May, June-August, September-November, and December-February were 7, 21, 27, and 21 mg/L, respectively. The lower value for March-May indicated that winter rains leached most of the root zone NO3-N beneath the wells by March, and that there was a 2 to 3 month lag between spring-applied N and its appearance in shallow groundwater. The study raises concern about shallow groundwater quality under intense multiple cropping systems on sandy soils. Although studies in this physiographic area of the Coastal Plain have shown that relatively impermeable subsoil horizons cause shallow groundwater to flow laterally to the larger drainage networks, and that alluvial forest then remove most of the N, the results of this study imply that groundwater NO3-N contamination could be a problem in other physiographic areas having sandy soils lacking such subsoil horizons. (Murphy-IVI)
W84-03949

RHODE ISLAND IMPOSES STRICT LIABILITY FOR CONTAMINATION OF WATER BY PERCOLATION OF POLLUTANTS FROM ILLEGAL DUMP SITE,
For primary bibliographic entry see Field 6E.
W84-03967

GREAT DRAIN ROBBERY,
F. Pearce.
New Scientist, Vol. 101, No. 1401, p 10-16, 15 March 1984. 4 Fig.

Descriptors: *Legislation, *Water pollution control, *Great Britain, Water pollution sources, Industrial wastes, Waste disposal, Waste dumps, Estuaries, Environmental effects, Tees Estuary.

Efforts on the part of the British government to legislate water pollution control are reviewed and cases are cited which suggest that these measures have in large part failed to have any real effect on the problem. The Control of Pollution Act was approved by parliament some 10 years ago. Over the past 30 years many of Britains worst polluters, the oil refineries, chemical works, steel plants and paper mills, have moved to the coasts and estuaries. Four government inquiries have been made as to how to clean up the Tees, Britain's most polluted estuary. Until last September local councils made most of the appointments to water authorities. The authorities are now wholly made up of ministers' nominees. Ministers appear to have a penchant for putting men from the top British companies onto the authorities. Specific examples of extreme cases of water pollution are cited. (Baker-IVI)
W84-03971

LONGITUDINAL DISPERSION IN A STREAM CALCULATED BY ONE DIMENSIONAL NUMERICAL MODEL,
Norsk Inst. for Vannforskning, Oslo.
For primary bibliographic entry see Field 2E.
W84-03975

QUANTITATIVE AND QUALITATIVE CHARACTERISTICS OF URBAN DISCHARGE TO SMALL RIVER BASINS IN THE SOUTH WEST OF SWEDEN,
Lund Univ. (Sweden).
W. Hogland, and R. Berndtsson.
Nordic Hydrology, Vol. 14, No. 3, p 155-166, 1983. 11 Fig, 1 Tab, 5 Ref.

Descriptors: *Rainfall-runoff relationships, *Urban runoff, *Sweden, *Lund, *Water pollution sources, Phosphorus, Snowmelt, Industrial wastes, Pollutograph, Copper, Zinc, Lead.

In the southwest of Sweden a common type of recipient for urban discharge is small rivers and creeks. Due to large variations in flow of these recipients, the polluted discharge can have different effects on aquatic life. The most critical periods often occur during summer. This is due to the very low flow during summer and heavy rainstorms which flush gutters and sewage pipes of pollutants and may cause combined sewer overflows. The receiving water for the city of Lund, Hoje river, is a typical recipient of urban discharge and is representative for the southwest of Sweden. Variations in pollution concentrations often occur within short time-periods. High concentrations in urban storm water can usually be traced to local pollution-sources. Examples of extreme values of different pollutants in urban stormwater from Lund are given. The high phosphorus concentration was due to overflow. High copper and zinc concentrations were found in areas with corroding copper and zinc roofs. Usually 75% of all data occurs around a narrow interval. When concentration values are found outside this interval, there is likely to be a local pollution source responsible. Such infomation can be used as an indicator for random samples. (Baker-IVI)
W84-03984

DISPERSION OF POLLUTANTS IN SEMI-INFINITE POROUS MEDIA WITH UNSTEADY VELOCITY DISTRIBUTION,
Banaras Hindu Univ., Varanasi (India). Dept. of Mathematics.
N. Kumar.
Nordic Hydrology, Vol. 14. No. 3, p 167-178, 1983. 3 Fig, 1 Tab, 17 Ref.

Descriptors: *Path of pollutants, *Seepage, *Porous media, *Dispersion, Flow, Water quality management, Water pollution control, Mathematical equations, Velocity, Groundwater movement.

Analytical solutions are developed for the dispersion problem in nonadsorbing and adsorbing, semi-infinite porous media in which the flow is one dimensional and the average flow velocity is unsteady. The expression that states the direct relationship of the dispersion coefficient with seepage velocity is used to solve the unsteady dispersion flow problem by introducing a new time variable. The source concentration of the pollutant varies exponentially with time. The variation in seepage velocity with time is considered because of resistance in the flow. The graphical solutions are also obtained for a set of data assumed. The analytical expressions obtained are useful to the study of salinity intrusion in groundwater, helpful in making quantitative predictions on the possible contamination of groundwater supplies resulting from groundwater movement through buried wastes. In addition, they should prove useful for other processes such as ion exchange in soils and decay of organic substances. (Baker-IVI)
W84-03985

ATMOSPHERIC NUTRIENT LOADINGS TO THE VENETIAN LAGOON,
Politecnico di Milano (Italy). Ist. di Ingegneria Sanitaria.
M. Guigliano, and R. Cossu.
The Science of the Total Environment, Vol. 29, No. 1/2, p 49-63, July 1983. 4 Fig, 5 Tab, 17 Ref.

Descriptors: *Phosphorus, *Nitrogen, *Lagoons, *Venice, *Italy, Fallout, Eutrophication, Adriatic Sea, Nutrients, Air pollution, Water pollution sources, Path of pollutants, Rainfall.

For the Lagoon of Venice (Italy), an evaluation of the nutrient loads discharged from the atmosphere is of particular interest, both because there are clear symptoms of progressive eutrophication of the lagoon as a whole and because there are industries in the area which emit nitrogen and phosphorus compounds which can increase the quantities carried in the air. Samples were taken from four points near the center of the lagoon around the city of Venice, over a period of 30 months. Monthly samples of rainwater were collected and analyzed for chemicals that showed the presence of nutrients (all the forms of nitrogen and phosphorus). The relationships between the various analytical parameters, sampling area, extent of the rainfall, and wind directions were studied using correlation coefficient matrices. The total quantity of nutrients that the atmosphere contributes to the lagoon is quite substantial and should not be ignored in the chemical balance of the ecosystem. (Baker-IVI)
W84-03997

ABUNDANCE OF SOME MAJOR AND TRACE ELEMENTS IN HIGHLY POLLUTED SEDIMENTS FROM THE RHINE RIVER NEAR MAINZ, WEST GERMANY,
Mainz Univ. (Germany, F.R.). Inst. fuer Geowissenschaften.
C. B. Dissanayake, H. J. Tobschall, H. Palme, U. Rast, and B. Spettel.
The Science of the Total Environment, Vol. 29, No. 3, p 243-260, August, 1983. 5 Fig, 3 Tab, 42 Ref.

Descriptors: *River sediments, *Pollutants, *Rhine River, *West Germany, *Mainz, Zinc, Silver, Gold, Rare earth elements, Uranium, Thorium, Chromium, Mercury, Cadmium, Hafnium, Galvinium, Sediments, Organic compounds.

The Ginsheimer Altrhein, which is a cut-off channel of the River Rhine near Mainz, is highly polluted, receiving waste effluent form a large industrial region. Neutron activation analysis was used to determine the abundances of 40 elements, including the rare earths, in the surface sediments of the River Ginsheimer Altrhein. Samples taken from 5 stations along the river contained very high concentrations of some elements such as zinc, 7160 ppm; silver, 154 ppm; gold, 750 ppb; copper 260 ppm; mercury, 94 ppm; and chromium, 1780 ppm. Significant enrichment due to anthropogenic sources was not evident among thorium (4-9 ppm) or uranium (2-8 ppm). Chalcophile, siderophile and lithophile elements showed very high positive correlations with organic carbon while the rare earth elements of Th, Hf, Ca, K, Ga, and Sc had negative correlations. (Baker-IVI)
W84-03998

IMPACT OF SEWAGE TREATMENT PLANTS ON SURFACE WATERS,
Toronto Univ. (Ontario). Dept. of Microbiology.
P. L. Seyfried, N. E. Brown, C. L. Cherwinsky, G. D. Jenkins, and D. A. Cotter.
Canadian Journal of Public Health, Vol. 75, No. 1, p 25-31, January/February, 1984. 2 Fig, 4 Tab, 37 Ref.

Descriptors: *Environmental impact statement, *Wastewater disposal, Surface water, Microbiolo-

gical studies, Wastewater pollution, Wastewater treatment, Chlorination, Bacteria, Staphylococcus, Amoebae, Viruses, Reoviruses, Adenoviruses, Enteroviruses, Coxsackie virus, Poliovirus, Recreation, Great Lakes, Lake Ontario.

The recent closure of some Ontario beaches has prompted investigations into possible sources of contamination of Lake Ontario. The role of sewage treatment plant effluents in microbial pollution of suface waters was analyzed through raw sewage, nonchlorinated and chlorinated effluent, and receiving waters for bacteria, amoebae and viruses. Determinations of total staphylococci, Pseudomonas aeruginosa, total coliforms, fecal coliforms, and fecal streptococci, from the raw sewage and outflow pipes of three sewage treatment plants, indicated that these organisms had a 0.02 to 0.008% survival rate after chlorination. Naegleria sp. were isolated from the raw sewage and sewage effluent of all three plants and, at one plant, the amoebae were also recovered from the chlorinated effluent and the lake water. Viruses were detected in 100% (11/11) of raw sewage, 63% (5/8) of nonchlorinated effluent, 40% (4/10) of chlorinated effluent and 4% (1/23) of receiving water samples. The viruses, identified using direct electron microscopic examination in combination with immunoelectron microscopy, were found to be reo-, adeno-, and enterovirus, coxsackievirus A9, B2 and B4, and poliovirus types 2 and 3. This study demonstrates that sewage treatment plants may have a detrimental impact on the water quality of recreational beaches. (Murphy-IVI)
W84-04010

ASSOCIATION OF NAEGLERIA FOWLERI WITH THE CHEMICAL, MICROBIOLOGICAL AND PHYSICAL CHARACTERISTICS OF SOUTH AUSTRALIAN WATER SUPPLIES,
South Australian Health Commission, Adelaide.
A. Esterman, M. Dorsch, S. Cameron, D. Roder, and B. Robinson.
Water Resources, Vol. 18, No. 5, p 549-553, 1984. 6 Tab, 10 Ref, 2 append.

Descriptors: *Naegleria fowleri, *Chemical properties, *Physical properties, *Microbiologal studies, Water supply, Amoebae, Pathogens, Water quality, Ecological distribution, Physiological ecology, Australia, Primary amoebic meningoencephalitis.

Primary amoebic meningoencephalitis (PAM) is a rare, though rapidly fatal, infection of the meninges and brain caused by the amoeba Naegleria fowleri. Control samples were compared with 102 water samples containing this pathogen. Generally, two controls were available for each sample where N. fowleri was detected. Univariate comparisons revealed a positive association of N. fowleri with: (a) water temperature; (b) maximum and minimum air temperature; (c) bacterial colony counts at 20 and 35 degrees C; (d) the total coliform count; (e) amoebae other than Naegleria and (f) Naegleria sp. other than N. fowleri. By comparison, negative associations were evident with free and total chlorine residuals. A conditional logistic regression analaysis indicated that N. fowleri isolation was positively and independently associated with: (a) water temperature; (b) maximum air temperature; (c) bacterial colony counts at 35 degrees C; and (d) low free chlorine residual. Negative associations were found with high temperature tolerant Naegleria and Acanthamoeba, but it is considered that these findings may reflect laboratory technique, not genuine ecological relationships. Evidence is presented that probability of detecting N. fowleri would vary markedly with the changes in mean water temperatures and maximum daily air temperature that occur by season. On the basis of temperature variations alone, and assuming a constant free chlorine residual, it is estimated that the probability of N. fowleri occurring (at detectable levels) would be 53 times higher in summer, eleven times higher in autumn, and six times higher in spring, than it would be in the winter. These are very approximate estimations which may not apply to an individual sampling site, nor to periods of extreme temperature. While this is a preliminary study, statistical associations of N. fowleri with a variety of ecological measures have been quantified. More comprehensive and detailed studies are required to further clarify the ecological relationships of this organism. (Murphy-IVI)
W84-04021

OCCURRENCE OF ROTA- AND ENTEROVIRUSES IN DRINKING AND ENVIRONMENTAL WATER IN A DEVELOPING NATION,
Texas Univ. Health Science Center at Houston.
T. R. Deetz, E. M. Smith, S. M. Goyal, C. P. Gerba, and J. J. Vollet, III.
Water Resources, Vol. 18, No. 5, p 567-571, 1984. 2 Tab, 25 Ref. NIH grant E30-1738 and contract AI-10266s.

Descriptors: *Rotaviruses, *Enteroviruses, *Drinking water, *Natural waters, Developing countries, Coliform, Coxsackie virus, Water quality, Standards, Potable water, Mexico.

Rotaviruses have been implicated as a major cause of childhood and traveler's diarrhea in developing countries. Since water is known to be a vehicle of transmission of other enteric viruses, we sought to determine if water could play a role in the transmission of rotavirus infections in a developing nation by applying recently developed techniques for the concentration of viruses from tapwater and environmental (lake, river, ocean and aqueduct) water in Mexico. In an initial survey during the rainy season in August 1978, rotavirus was detected in 10 of 10 drinking water samples and coxsackie B4 or B6 virus in 5 of 10. In a larger survey during the dry season in December 1979, rotavirus was recovered from 3 and enteric viruses from 8 of 21 drinking water samples. Water quality data, available for the 1979 survey, indicated that while many tapwater samples did not meet U.S. coliform standards, some samples containing infectious virus did. Our data suggest that current bacteriological water quality standards for potable water do not reflect viral contamination. (Author's abstract)
W84-04023

MEASUREMENT OF ELECTRON TRANSPORT SYSTEM (ETS) ACTIVITY IN FRESHWATER SEDIMENT,
Guelph Univ. (Ontario). Dept. of Environmental Biology.
J. T. Trevors.
Water Resources, Vol. 18, No. 5, p 581-584, 1984. 6 Fig, 2 Tab, 9 Ref.

Descriptors: *Electron transport system, *Sediment, Electrochemistry, Electron transport, Microbial degradation, Oxygen requirements.

Electron transport system (ETS) activity was measured in freshwater sediment at 4, 10 and 20 degrees C by following the reduction of 2-(p-iodophenyl)-3-(p-nitrophenyl)-5-phenyl tetrazolium chloride (INT) to iodonitrotetrazolium (INT-formazan). The rate of INT-formazan formation was dependent upon the incubation temperature and nutrient amendments. Electron transport system activity also correlated very highly with O2 consumption rates in the same sediment. (Author's abstract)
W84-04024

BACTERIA IN DISTRIBUTION SYSTEMS (LA FLORE BACTERIENNE DANS UN RESEAU DE DISTRIBUTION),
Compagnie Generale des Eaux, Paris (France).
M. M. Bourbigot, A. Dodin, and R. Lheritier.
Water Resources, Vol. 18, No. 5, p 585-591, 1984. 2 Fig, 7 Tab, 16 Ref.

Descriptors: *Bacteria, *Water distribution, Water quality, Drinking water, Disinfection, Bacterial analysis, Water treatment, Paris, France.

Water quality upkeep in distribution systems is a major concern of drinking water suppliers, especially where systems transport water through several thousand kilometers of pipelines. The Water Authority for the Paris Suburbs' decided to modify treatment at the Mery-sur-Oise drinking water production plant. The old line was upgraded by the addition of a raw water basin, two more ozonation stages, and activated carbon filtration. Pre-chlorination is no longer used at the plant. A study to assess the impact of these changes on the quality of water in the system was launched prior to the switchover. It involved the enumeration and identification of the germs in analyzed samples of river water, treated water and distributed water. The mean value of the total bacterial aftergrowth in the distribution system of the old line, at 20 degrees C exceeded the limit value of the European standards (100 germs/ml). Removal of the biodegradable fraction of organics during treatment probably limits the aftergrowth, in spite of lower post-chlorination dosages. Moreover, chlorine is now in the form of free chlorine. TOC removal has been increased slighty by the new line, but the permanganate consumption has been greatly reduced, from 1.5 to 0.5/mg at the plant outlet. In river water, the germs are mainly Escherichia, Aeromonas hydrophila, Acinetobacter calcoaceticus, Alcaligenes faecalis. Yersinia enterocolitica were isolated in 6% of the samples. At the plant outlet, the samples are mostly uncontaminated in analysis conditions. In the distribution system, the species isolated are Aeromonas hydrophila and Alcaligenes faecalis. Enterobacteriaceae and Pseudomonodaceae also contaminated the samples, but with a very low frequency (5%). Many acid-fast bacteria species were isolated in river water (M. fortuitum, M. chelonei, M. terrae and M. lactis). But no species were found in samples of 250 ml at the plant outlet. 39 acid-fast bacteria were isolated from 126 samples of distributed water. Most germs belong to Runyon's group II but were not identified. The onset of deterioration of bacteriological quality may be a criterion for selecting the regeneration cycle for activated carbon. (Murphy-IVI)
W84-04025

SEDIMENTARY COPROSTANOL AND HYDROCARBON DISTRIBUTION ADJACENT TO A SEWAGE OUTFALL,
Mote Marine Lab., Sarasota, FL.
R. C. Brown, and T. L. Wade.
Water Resources, Vol. 18, No. 5, p 621-632, 1984. 9 Fig, 3 Tab, 38 Ref.

Descriptors: *Coprostanol, *Hydrocarbons, *Wastewater outfall, Fate of pollutants, Sediments, Indicators.

The concentrations of coprostanol and hydrocarbons were measured in the effluent from the Chesapeake-Elizabeth sewage treatment plant (STP) and surface sediments from the area surrounding the effluent discharge site. Most of the coprostanol (> 84%) and hydrocarbons (> 91%) were associated with particulates in the effluent. The area was found to be dynamic where changes in the percentage and distribution of fine grained sediments occur over periods of months and the movement of these sediments is an important determinant of the distribution of sewage derived contaminants. The Chesapeake-Elizabeth STP was found to be responsible for only 7% of the hydrocarbon contamination of the sediments in the study area. The sediment hydrocarbon distribution also indicates that the Bay Bridge tunnel may be a unique source of hydrocarbons to the lower Chesapeake Bay. This study shows the usefulness of coprostanol in providing a better understanding of the fate and importance of sewage derived contaminants in areas around sewage outfalls. (Author's abstract)
W84-04028

BEHAVIOR OF FE, MN, CU AND CD IN THE DUWAMISH RIVER ESTUARY DOWNSTREAM OF A SEWAGE TREATMENT PLANT,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
A. J. Paulson, R. A. Feely, H. C. Curl, and J. F. Gendron.
Water Resources, Vol. 18, No. 5, p 633-641, 1984. 6 Fig, 2 Tab, 34 Ref, 1 Append.

Descriptors: *Behavior, *Iron, *Magnesium, *Copper, *Cadmium, *Duwamish River,

Wastewater outfall, Estuaries, Chemical properties, Fate of pollutants, Seattle, Washington.

Although the fate of sewage-derived trace metals in fresh and marine waters is only beginning to be understood, their partitioning between dissolved and particulate phases is known to play an important role in determining their fate. The behavior of dissolved Fe, Mn, Cu and Cd in the Duwamish River downstream of a sewage treatment plant located near Seattle, Washington, was investigated in three distinct zones: (1) immediately downstream of the effluent outfall, (2) further downstream in the freshwater portion of the river and (3) in the estuaring mixing zone. A three-end-member tracer model utilizing salinity and dissolved inorganic nitrogen was developed to distinguish physical mixing process from biogeochemical reactions. The results of this investigations indicate that Fe was removed from the dissolved phase onto particulates near the plant. Although no additional reactions controlled the distribution of dissolved Fe, Mn and Cu in the freshwater portion of the river, Cd was removed from the dissolved phase. In the estuarine mixing zone, a significant fraction of the dissolved Fe and Cu was removed from solution, while Mn and Cd desorbed from particulates. The chemical forms of the trace metals rather than their sources appear to determine their participation in these reactions. (Murphy-IVI)
W84-04029

RESIDUES OF ORGANOCHLORINE INSECTICIDES, POLYCHLORINATED BIPHENYLS, AND HEAVY METALS IN BIOTA FROM APALACHICOLA RIVER, FLORIDA, 1978,
Georgia Univ., Athens.
P. V. Winger, C. Sieckman, T. W. May, and W. W. Johnson.
Journal Association of Official Analytical Chemists, Vol. 67, No. 2, March-April, 1984. 3 Fig, 8 Tab, 28 Ref.

Descriptors: *Organochlorine insecticides, *Polychlorinated biphenyls, *Heavy metals, *Biota, *Apalachicola River, Insecticides, DDT, Toxaphene, Organic compounds, Organic pesticides, Standards, Water pollution, Fate of pollutants, Bioindicators, Florida.

Seventy-seven composite samples composed of largemouth bass (Micropterus salmoides), channel catfish (Ictaluras punctatus), threadfin shad (Dorosoma petenense), Asiatic clam (Corbicula Fluminea), burrowing mayfly (Hexagenia sp.), water snake (Natrix spp.), and little green heron (Butorides virescens) were collected from upper and lower reaches of the Apalachicola River, Florida, in 1978 for residue analysis of organochlorine insecticides, PCBs (polychlorinated biphenyls), and metals. Compared with data from the National Pesticide Monitoring Program and criteria recommended for the protection of aquatic life, residue concentrations were moderately high in the Apalachicola River. Biota from the upper river generally had higher organic and lower metal residues than those from the lower river. Highest residues in the biota were total DDT, total PCBs, and toxaphene. Although individual mean concentrations were below 2 microg/g and total organic contaminant residues never exceeded 5 microg/g, residue concentrations of DDT, PCBs, and toxaphene (particularly from the upper river) exceeded recommended permissible levels for the protection of aquatic life. Metal residues were generally below 1 microg/g. Exceptions were arsenic residues in threadfin shad (1.07 microg/g) and Asiatic clams (1.75 microg/g), and selenium in eggs of channel catfish (1.39 microg/g). The residues observed in the biota, particularly from the upper station, indicated moderate contamination of the Apalachicola River system at the time samples were collected. (Author's abstract)
W84-04033

ADSORPTION OF HYDROPHOBIC POLLUTANTS IN ESTUARIES,
Manhattan Coll., Bronx, NY. Environmental Engineering and Science Program.
J. P. Connolly, N. E. Armstrong, and R. W. Miksad.
Journal of Environmental Engineering, Vol. 109, No. 1, p 17-35, February, 1983. 13 Fig, 2 Tab, 23 Ref.

Descriptors: *Fate of pollutants, *Kepone, *Estuaries, *Adsorption, Suspended sediments, Simulation, Model studies, Tidal effects, Resuspension, Mathematical models, Pesticides.

Using Kepone as the test compound, the relation of sediment suspension to fate of hydrophobic pollutants through adsorption is examined. Adsorption experiments show rapid attainment of an equilibrium condition that is a linear function of dissolved Kepone concentration and an inverse non-linear function of adsorbing solids concentration. An apparatus creating a one-dimensional distribution of suspended sediment over a sediment bed is used to experimentally simulate an estuarine tidal cycle during which the transfer of Kepone from the bed to water column is examined. A mathematical model of the adsorption and sediment resuspension process is used to analyze the experimental results. Resuspension and the variation of adsorption equilibrium with solids concentration are shown to be significant to the transfer. Adsorption kinetics are not significant because of the rapid approach to equilibrium. (Author's abstract)
W84-04042

ORGANIC CARBON DECAY IN STREAM WITH BIOFILM KINETICS,
Montana State Univ., Bozeman. Dept. of Civil Engineering and Engineering Mechanics.
S. Srinanthakumar, and A. Amirtharajah.
Journal of Environmental Engineering, Vol. 109, No. 1, p 102-119, February, 1983. 14 Fig, 42 Ref.

Descriptors: *Biofilms, *Microorganisms, *Fate of pollutants, *Kinetics, *Mathematical models, *Organic carbon, Decomposition, Streams, Wastewater, Biomass, Velocity, Water temperature.

The importance of sessile microbial populations in aquatic environments has been recognized for many years especially the heterotrophic slimes under polluted conditions. However, models proposed by previous researchers to predict substrate decay rates have been based on first order or Monod kinetic expressions describing substrate utilization by suspended biomass. The investigation carried out looks at two important aspects of organic carbon modeling in a shallow stream: (1) it compares the importance of suspended microbial populations to the biofilm community and (2) it determines the kinetics of organic carbon uptake rate by river biofilms using an artificial stream channel. The results confirmed the dominance of attached microbial films in removing organic carbon in a shallow turbulent river. The study provided the organic carbon uptake rate (RB) and the net scour rate (RD) for the biofilms while establishing the validity of first order kinetics in a specified range of substrate concentrations, flow velocity and temperature. Mathematical models were formulated and verified under steady state conditions for the organic carbon and biomass change below a sewage outfall in a selected river system. (Author's abstract)
W84-04046

MOST RAPID BOD ASSIMILATION IN GANGA AND YAMUNA RIVERS,
Roorkee Univ. (India). Dept. of Civil Engineering.
D. S. Bhargava.
Journal of Environmental Engineering, Vol. 109, No. 1, p 174-188, February, 1983. 7 Fig, 6 Tab, 16 Ref.

Descriptors: *Biochemical oxygen demand, *Fate of pollutants, *Ganga, *Ganges, *Yamuna, *India, Bioflocculation, Aeration, Dissolved oxygen, Municipal wastewater, Mathematical models, Kinetics.

During a water quality survey of the Ganga and Yamuna of the Indogangetic plain, the assimilation of biochemical oxygen demand (BOD) after the waste outfalls at the urban centers along these rivers was found to be exceedingly fast. During the two-stage BOD removal in these streams, the early reaches resulted from bioflocculation of waste colloidal matter with river water. It was found to follow a straight line law approximately a BOD rate constant (k) of as high values as 30 to 100 day-1 (base e) resulting in about 60% BOD removal in 30 min-60 min. In the later reaches, the BOD removal was found to follow the usual first order kinetics with k ranging from 1.5 to 5.5/day (base e) which are higher by an order of magnitude than the usual range of 0.2 to 0.5/day (base e). The dissolved oxygen (DO), which dropped to low values after the waste outfalls, was also found to recover in short times showing extremely fast reaeration. Such BOD exertion and reaeration have been modelled. The integrated effect of several drains releasing at an urban center has also been included in the prediction of BOD and DO. (Author's abstract)
W84-04048

SOURCES AND MOLECULAR WEIGHT OF 'DISSOLVED' ORGANIC CARBON IN AN OLIGOTROPHIC LAKE,
Marine Biological Lab., Woods Hole, MA. Ecosystems Center.
For primary bibliographic entry see Field 2H.
W84-04053

RAIN AND SNOW SCAVENGING OF HNO3 VAPOR IN THE ATMOSPHERE,
Ford Motor Co., Dearborn, MI. Research Staff.
T. Y. Chang.
Atmospheric Environment, Vol. 18, No. 1, p 191-197, 1984. 30 Ref.

Descriptors: *Rainfall, *Scavenging, *Water pollution sources, Nitrates, Precipitation, Air pollution, Acidity, Acid rain, Precipitation rate, Snow.

Wet removal coefficients for HNO3 vapor from the atmosphere by rain (in-cloud and below-cloud, washout) and snow have been derived under a number of approximations. The coefficients are parameterized in terms of precipitation rate. The coefficients represent average scavenging from large precipitation bands or frontal systems over horizontal scales of 50 km or more where there is widespread weakly ascending air motion. Because a number of approximations are involved in the derivation of these coefficients, there exist significant uncertainties in the derived expressions, particularly in the snow scavenging coefficients. The derived coefficients would be appropriate, on an interim basis, for inclusion into regional or mesoscale models which include the wet removal of HNO3 vapor. When combined with altitude-dependent precipitation rates and vertical profiles of HNO3 concentrations, these coefficients are also useful to estimate the flux of HNO3 to the earth's surface. The derived snow scavenging coefficients are consistent with those of recent measurements. Rain and snow scavenging coefficients are also consistent with recent observations of ionic composition in winter precipitation samples which indicates that snow removes HNO3 vapor more efficiently than rain. (Baker-IVI)
W84-04063

MODEL FOR SULPHATE IN STREAMWATER AT STORGAMA, SOUTHERN NORWAY,
Sentralinstitutt for Industriell Forskning, Oslo (Norway).
N. Christophersen, L. H. Dymbe, M. Johannssen, and H. M. Seip.
Ecological Modelling, Vol. 21, No. 1 and 2, p 35-61, 1983/1984. 13 Fig, 4 Tab, 39 Ref.

Descriptors: *Sulfate, *Path of pollutants, Norway, Storms, Rainfall, Runoff, Storgama, Model studies, Snowpack, Snowmelt, Seasonal variations, Streams, Telemark county.

The sulfate budget and a model for sulfate concentrations in streamwater have been established for a small, gauged catchment in Telemark county, southern Norway. The annual input roughly balances the output. The average annual flux through the catchment for four years is about 3500 mg

sulfate/sq m. Typical seasonal trends, such as the fairly stable winter concentrations and the decrease during melting, are reproduced in a model which is based on a simple reservoir hydrologic model. In the model, water-soluble sulfate accumulated in the reservoir representing the surface soils during dry periods because of dry deposition, evapotranspiration of summer rainfalls and mineralization. During wet summer periods, water-soluble sulfate is removed due to reduction adsorption. The concentration pattern during snowmelt is largely dependent on the fractionation of sulfate held by the snowpack. The model is particularly useful as a data interpretation tool. The difference between wet and dry summers is also clearly shown. A systematic discrepancy occurs in the initial phase of the snowmelt where the predicted concentrations are always too low. (Baker-IVI)
W84-04065

EFFECTS OF ACID RAIN ON WATER SUPPLIES IN THE NORTHEAST,
New England Water Works Association, Dedham, MA.
F. B. Taylor, and G. E. Symons.
American Water Works Association Journal, Vol. 76, No. 3, p 34-41, March, 1984. 4 Fig, 13 Tab, 17 Ref.

Descriptors: *Acid rain, *Public health, *Drinking water, Aquifers, Watersheds, New England, Groundwater, Surface waters, Precipitation, Corrosion, Economic factors.

Surface water and groundwater supplies were sampled in New England, and some sites in the Northeast and the Appalachians to determine the impacts of acid precipitation on drinking water, in terms of health effects in humans. During this study the adverse effects of acid rain on human health through ingestion of surface water supplies was not demonstrated, but the data show that unadjusted aluminum content in a number of supplies could be a problem to patients on kidney dialysis. Though the quantification remains to be established, it is reasonable to assign some part of the highly corrosive nature of New England waters to acidic deposition because of the poorly buffered watersheds and aquifers. Historical data, as demonstrated in the case described showed that highly aggressive waters have been encountered for a long time. A system for classifying watersheds and aquifers is proposed. (Baker-IVI)
W84-04082

FIELD MONITORING OF CHRYSOTILE ASBESTOS IN CALIFORNIA WATERS,
California Dept. of Health Services, Berkeley. Air and Industrial Hygiene Lab. Section.
S. B. Hayward.
Journal of the American Water Works Association, Vol. 76, No. 3, p 66-73, March, 1984. 9 Fig, 7 Tab, 29 Ref.

Descriptors: *Asbestos, *California, *Drinking water, Water supply, Serpentine, Watersheds, Water pollution sources, Reservoirs, Seasonal variation, Water treatment, Coagulation, Turbidity.

Asbestos contamination in sources of drinking water in the state of California is being monitored. Contamination of surface water supplies draining serpentine-containing watersheds of being stored in reservoirs in contact with serpentine deposits is usually >100 MFL and has been found to be as high as 200,000 MFL. Concentrations in water supplies draining serpentine-containing watershed exhibit seasonal variations, with the largest concentrations occurring during or just following heavy rains in the watershed. Some of the concentrations were the highest measured anywhere in the world. Asbestos was also found in groundwater taken from wells that are recharged through serpentine rock. Water treatment was found to have widely varying success in the removal of asbestos fibers. Reduction by a factor of 50,000 was observed as a result of conventional coagulation-filtration in one case. Data on treatment suggest that the percentage removal of fibers depends on the initial concentration. Asbestos concentrations have been found to correlate well with turbidity in only a few limited cases. (Moore-IVI)
W84-04087

NATIONWIDE ASSESSMENT OF URBAN RUNOFF IMPACT ON RECEIVING WATER QUALITY,
Florida Water Resources Research Center, Gainesville.
J. P. Heaney, and W. C. Huber.
Water Resources Bulletin, Vol. 20, No. 1, p 35-42, February, 1984. 2 Fig, 5 Tab, 14 Ref. EPA grant 805663.

Descriptors: *Urban runoff, *Combined sewer overflows, *Environmental effects, *Water quality, Water pollution effects, Fish kills, Beaches, Dissolved oxygen, Storm runoff.

Urban stormwater runoff has been recognized as a potential major contributor of pollution to receiving waters. However the projected high costs of control have prompted an examination of the extent to which these impacts have been documented. A nationwide search was conducted for case studies demonstrating a cause-effect linkage between urban runoff and impairment of beneficial uses in receiving waters. Documented case studies of impacts of urban runoff and combined sewer overflows on receiving water are scarce. Impacts of other discharges mask the impacts of urban runoff, and the expected impacts from urban runoff are relatively subtle. The existance of numerous definitions of the word 'impact' make it difficult to devise meaningful rankings of impacts. No clear line of demarcation exists to destinguish the urban drainage system from the receiving water, especially for small creeks and ponds. Some evidence exists that urban runoff is a cause of fish kills and beach closings. The studies of dissolved oxygen records downstream of urban areas have produced the most definitive information regarding the impact of wet weather flows. Stormwater discharges dampen the diurnal fluctuations in dissolved oxygen and can reduce the overall dissolved oxygen levels. If receiving water impacts are to be evaluated for environmental decision making, then a problem solving framework is needed. (Moore-IVI)
W84-04102

FECAL COLIFORM RELEASE FROM CATTLE FECAL DEPOSITS,
Utah State Univ., Logan. Coll. of Natural Resources.
M. Kress, and G. F. Gifford.
Water Resources Bulletin, Vol. 20, No. 1, p 61-66, February, 1984. 7 Fig, 24 Ref. OWRT project JNR 048-Utah.

Descriptors: *Feces, *Coliforms, *Cattle, *Water pollution sources, Fecal coliforms, Rainfall intensity, Bacteria.

Cowpies molded to a standard configuration and size were subjected to simulated rainfall, and the fecal coliform counts were determined using the most probable number (MPN) method of enumeration. The standard cowpie deposits were exposed to simulated rainfall once at ages 2 through 100 days. The effects of rainfall intensity and recurrent rainfall were also tested. Naturally-occurring fecal deposits were also tested to compare their results with those from the standard cowpies. A log-log regression was found to describe in peak fecal coliform release with fecal deposit age. The 100-day-old fecal deposits produced peak counts of 4,200 fecal coliform per 100 milliliters of water. This quantity of release is minimal compared to the release from fresher fecal material. Rainfall intensity had little effect on peak fecal coliform release from fecal deposits that were 2 or 10 days old. At age 20 days the effect of rainfall intensity was significant; the highest intensity gave the lowest peak counts, and the lowest intensity gave the highest peak counts. The effect of rainfall intensity appears to be related to the dryness of the fecal deposits. Peak fecal coliform counts were significantly lower when the fecal deposits were rained on more than once. This decline was thought to be produced by the loss of bacteria from the fecal deposits during the previous wettings. Standard cowpies produced a peak release regression that was not significantly different from the regression for the natural fecal deposits. Apparently, grossly manipulating the fecal deposits did not significantly change the release patterns. (Author's abstract)
W84-04105

CHEMICAL COMPOSITION OF SOFTWATER FLORIDA LAKES AND THEIR SENSITIVITY TO ACID PRECIPITATION,
Environmental Science and Engineering, Inc., Gainesville, FL.
For primary bibliographic entry see Field 2H.
W84-04107

DENITRIFICATION: ITS IMPORTANCE IN A RIVER DRAINING AN INTENSIVELY CROPPED WATERSHED,
York Univ., Toronto (Ontario). Dept. of Geography.
A. R. Hill.
Agriculture, Ecosystems and Environment, Vol. 10, No. 1, p 47-62, August, 1983. 2 Fig, 4 Tab, 36 Ref.

Descriptors: *Nitrogen, *Water pollution sources, *Fate of pollutants, *Nottawasaga River, *Ontario, Fertilizers, Nitrates, Groundwater pollution, Denitrification, Sediments, Path of pollutants.

Nitrogen transport was studied during summer low flows in a 20-km reach of the Nottawasaga River (Ontario) which drains an intensively cropped sand plain which has an underlying shallow water-table aquifer. Nitrogen inputs to the river were measured on 30 days in May to October of 1977-81. These data indicated that about 38% of the daily nitrate input entered the river through ground water. The magnitude of this input is a consequence of widespread contamination of the shallow aquifer by nitrogen fertilizer. Ground water entering the river from springs and seeps near fertilized fields frequently contained more than 10 mg/l of NO3-N. Mass balance studies of nitrogen transport in the river revealed an average daily nitrate loss of 46 + or - 23 kg N. This rate of nitrate removal represented about 40% of the ground water input to the river from the sand plain. Analysis of a mass balance for total Kjeldahl nitrogen revealed an essentially balanced budget, whereas chloride showed a small daily gain of about 5%. Laboratory experiments involving the incubation of stream sediment cores and the use of the acetylene block technique suggested that the bulk of the nitrate loss during river transport was caused by denitrification in bottom sediments. (Author's abstract)
W84-04113

DISPERSION SCALE EFFECT IN MODEL CALIBRATIONS AND FIELD TRACER EXPERIMENTS,
Texas A and M Univ., College Station. Dept. of Geology.
P. A. Domenico, and G. A. Robbins.
Journal of Hydrology, Vol. 70, No. 1-4, p 123-132, 1984. 1 Fig, 1 Tab, 16 Ref.

Descriptors: *Dispersion, *Model studies, *Tracers, Groundwater pollution, Path of pollutants, Dispersivity, Model scale, Plumes.

Field tracer experiments and model calibrations indicate that the magnitude of dispersivity increases as a function of the scale at which observations are made. Calculations presented in this study suggest that some part of this scaling may be explained as an artifact of the models used. Specifically, a scaling-up of dispersivity will occur whenever an (n - 1)-dimensional model is calibrated or otherwise employed to describe an n-dimensional system. The calibrated coefficients for such models will depend not only on size of the contaminant plume or tracer experiment at the time of calibration, but will exhibit a size dependency beyond the calibration period. The magnitude of scaling appears to be sufficient to encompass the range of differences between laboratory measurements of

dispersivity and model calibrations. (Author's abstract)
W84-04146

RAPID PREDICTION OF THE EXTENSION OF POLLUTION IN SOME CASES OF EFFLUENT AND METHOD OF INJECTION (PREVISION RAPIDE DE L'EXTENSION D'UNE POLLUTION DANS QUELQUES CAS D'ECOULEMENT ET DE MODE D'INJECTION),
Lille-1 Univ., Villeneuve d'Ascq (France). Lab. de Geologie Appliquee.
N. Crampon.
Journal of Hydrology, Vol. 70, No. 1-4, p 149-165, 1984. 4 Fig, 9 Ref.

Descriptors: *Path of pollutants, *Dispersion, Groundwater pollution, Wells, Saturated flow, Groundwater movement, Mathematical models.

The relationship between maximum concentration and longitudinal distance, independent of time, can determine the size of the area to be contaminated, under well-defined conditions of injection and flow in a saturated medium. The envelope curve for maximal concentrations is easily obtained as a function of the axial distance in nondimensional variables in the cases of one- and two-dimensional uniform flow, as well as in those of radially symmetric converging or diverging flow. Graphs providing relations between dimensionless variables are given for the following cases: (1) uniform flow with instantaneous discharge of a pollutant; measurement downstream of the injection point, no transverse dispersion; (2) uniform flow with continuous injection of a pollutant; measurement downstream of the injection point, influence of transverse dispersion included; (3) convergent radial flow towards as well; pollution caused by an instantaneous point-source at some distance; and (4) divergent radial flow from an injection point; pollution caused by instantaneous injection of a pollutant. (Author's abstract)
W84-04148

ANALYTICAL SOLUTION FOR CHEMICAL TRANSPORT WITH NONEQUILIBRIUM MASS TRANSFER, ADSORPTION AND BIOLOGICAL TRANSFORMATION,
Institut Fotosinteza, Pushchino (USSR).
E. V. Mironenko, and Ya. A. Pachepsky.
Journal of Hydrology, Vol. 70, No. 1-4, p 167-175, 1984. 1 Fig, 1 Tab, 29 Ref.

Descriptors: *Path of pollutants, *Nitrates, Denitrification, Model studies, mathematical equations, Solute transport, Sorption.

An analytical solution is presented for the set of equations describing chemical transport in soils with dispersion, presence of a stagnant liquid phase and sorption, in which the solute is involved in biological or chemical transformations. The model is used for description of nitrate transport and denitrification in a soil column. Both the case of constant input concentration of migrant and the case of a concentration pulse were considered. (Baker-IVI)
W84-04149

DISTRIBUTION, SOURCE AND EVOLUTION OF NITRATE IN A GLACIAL TILL OF SOUTHERN ALBERTA, CANADA,
Department of Agriculture, Lethbridge (Alberta).
M. J. Hendry, R. G. L. McCready, and W. D. Gould.
Journal of Hydrology, Vol. 70, No. 1-4, p 177-198, 1984. 10 Fig, 6 Tab, 43 Ref.

Descriptors: *Nitrates, *Glacial till, *Alberta, *Water pollution sources, *Groundwater pollution, Tritium, Bacteria, Denitrification.

This paper addresses the distribution, origin and controls upon nitrate in a 30-sq km area of the Interior Great Plains Region of southern Alberta, Canada. High concentrations of nitrate (>100 mg/l NO3(-)-N) occurred in several isolated enclaves below the water table in brown weathered till. Nitrate concentrations of over 300 mg/l(-)-N were encountered in groundwater samples collected from these enclaves. Low nitrate concentrations (<1.1 mg/l NO3(-)-N) were also encountered in the weathered till upgradient and downgradient of the nitrate enclaves. Groundwater samples collected from the underlying grey nonweathered till and bedrock had NO3(-)-N concentrations of <1.1 mg/l. Through the application of geochemical (NO3(-)-N and NH4(+)-N) studies, environmental isotope studies (tritium), microbial analyses (nitrifiers) and laboratory experiments, it was shown that the high nitrates found in the weathered till are the result of the oxidation of ammonium present within the tills. It is postulated that this oxidation occurred during the Holocene epoch when water tables were much lower than present-day levels (5-18 m, and 2 m below ground, respectively). Through the use of Eh measurements, the enumeration of denitrifying bacteria and laboratory experiments, the potential for denitrification was shown to exist below the present-day water table in the weathered till as well as in the nonweathered till and bedrock. Isotopic data showed that less dentrification may be occurring within the nitrate enclaves than in adjacent downgradient areas. (Author's abstract)
W84-04150

LEACHING OF ALDICARB AND THIOFANOX, AND THEIR UPTAKE IN SOILS BY SUGARBEET PLANTS,
Ghent Rijksuniversiteit (Belgium). Dept. of Crop Protection Chemistry.
W. Dejonckheere, W. Steurbaut, G. Melkebeke, and R. H. Kips.
Pesticide Science, Vol. 14, No. 2, p 99-107, April, 1983. 9 Tab, 15 Ref.

Descriptors: *Leaching, *Insecticides, *Beets, Path of pollutants, Irrigation, Aldicarb, Thiofanox, Pesticide residues.

The leaching of aldicarb and thiofanox in soils (sandy loam, silt loam and sandy clay loam), and their uptake by sugarbeet plants were studied. Three irrigation levels were maintained: half, normal and double dose. The residues were determined as the sum of the insecticidal metabolites (parent compound + sulfoxide + sulphone) for both pesticides. Leaching was greatly influenced by the amount of water added and the soil type. Under normal conditions, leaching seemed to proceed very slowly, keeping the chemicals available for uptake by the root systems for a long time. The concentration of insecticide in the leaves was highest in beets grown on sandy loam and lowest in those grown on sandy clay loam. The quantity of irrigation did not influence the residue concentration in the leaves greatly, although its influence was obvious on the total residue present (micro g per plant). Increasing the water dose always resulted in a higher total residue, and a greater plant weight. The breakdown in the soils was directly related to the water dose. The experiments show that thiofanox was more stable than aldicarb and was taken up by sugarbeet to a greater extent. (Author's abstract)
W84-04177

HERBICIDE RESIDUES IN WASTE WATERS FROM RICEFIELDS,
Cagliari Univ. (Italy). Facolta de Farmacia.
P. Cabras, P. Diana, M. Meloni, F. M. Pirisi, and R. Pirisi.
Pesticide Science, Vol. 14, No, 2, p 130-134, April, 1983. 1 Fig, 3 Tab, 10 Ref.

Descriptors: *Pesticide residues, *Herbicides, *Insecticides, *Rice, Wastewater, Water pollution sources, Pesticide residues.

The potential pollution of the ricefields by herbicides can be defined by the empirical quantity theoretical maximum concentration (TMC), which is the concentration of the herbicides in the water when their sprayed amounts are dissolved in an average depth of water (about 20 cm). The herbicides bentazone, 2,4-D, MCPA, propanil, molinate, and tiocarbazil, and the insecticide phenthoate, were applied to ricefields at rates equivalent to maximum aqueous concentrations of 0.4-2.8 mg/kg, assuming the water to be 20 cm deep. Their concentrations in water were measured by high-performance liquid chromatography. The TMC values are compared with the corresponding LC50 values for fish, the water solubility, and the minimum detectable value (MDV) achievable with the analytical technique used. All of the MDVs were at least 100 times lower than the TMC values. The TMC values are less than their water solubility. They are also lower than the LC50 values for fish, except for propanil. Residues in 162 water samples, collected from 16 ricefields, 1, 4, 7, 10, 12, 18, 21 and 120 days after the last spraying, were all below the limit of determination (0.03 mg/kg). Residues in 40 water samples taken from five drainage canals were also less than 0.03 mg/kg. (Moore-IVI)
W84-04178

5C. Effects Of Pollution

EFFECTS OF ACIDIFICATION ON THE COMPOSITION OF MOUNTAIN BROOK BIOCOENOSES, SCHLITZ STUDIES ON PRODUCTIVITY, NO. 54 (DER EINFLUSS DER VERSAUERUNG AUF DIE ZUSAMMENSETZUNG VON BERGBACHBIOZONOSEN, SCHLITZER PRODUKTIONSBIOLOGISCHE STUDIEN, 54),
Gesamthochschule Kassel (Germany, F.R.). Inst. fuer Zoologie.
U. Matthias.
Archiv fur Hydrobiologie, Suppl. 65 No. 4, p 407-483, December, 1983. 20 Fig, 16 Tab, 125 Ref.

Descriptors: *Acid rain, *Aquatic animals, *Water pollution effects, Acidity, Invertebrates, Snowmelt, Rainfall, Nitrates, Sulfates, Germany, Kassel, Brooks, Land use, Hydrogen ion concentration.

Five small brooks in the Kaufunger Wald (near Kassel, West Germany) with different degrees of acidification were chemically and biologically investigated in a wooded red stone area near Kassel within a period of two years. The acidification may be due to acid precipitation, land use changes and cation exchange in humic substances with the first cause being the suspected major one. Recorded pH-minima were always connected with times of heavy rainfall or snow melt. Eighty species of aquatic invertebrate fauna were collected in a neutral brook. In a weakly acidic brook, only 42 of these species were present, and in the strongly acid brooks with mean pH levels of 4.7, 4.5, and 4.1, only 21, 17, and 15 species were found respectively. In the Kaufunger Wald, the hydrogen ion concentration operates directly to restrict the benthic invertebrate fauna. (Baker-IVI)
W84-03506

HYDROCHEMICAL STUDIES OF THE VELIKA MORAVA RIVER AND ITS TRIBUTARIES (HYDROCHEMISCHE UNTERSUCHUNGEN DER VELIKA MORAVA UND IHRER NEBENFLUSSE),
Institute for Biological Research, Belgrade (Yugoslovia).
G. Petrovic.
Archiv fur Hydrobiologie, Suppl. 68, No. 1, p 1-14, October, 1983. 16 Fig, 5 Tab, 5 Ref.

Descriptors: *Water pollution effects, *Rivers, *Sediments, Water quality, Velika Morava River, Yugoslavia, Drainage basins, Domestic wastes, Industrial wastes, Water pollution sources, Cadmium, Chromium.

Velika Morava is the largest tributary of the Danube in Serbia (Yugoslavia). Hydrochemical studies of water and sediments of the Velika Morava and its tributaries - the Kalenicka, Lugomir, Belica and Resava Rivers, as well as of its constituent rivers, the Zapadna and Juzna Morava, have been made to assess the water quality in the drainage basin of the main river. The levels of cadmium and chromium in the sediments of Velika Morava are elevated. Both industrial and domestic waste waters are impairing the quality of the waters studied to such a degree that adequate measures are needed for their protection, which

eventually would contribute to the protection of the Danube. (Baker-IVI)
W84-03509

BENTHIC ALGAE OF THE DANUBE IN THE NEIGHBOURHOOD OF VIENNA (DIE BENTHISCHEN ALGEN DER DONAU IM RAUM VON WIEN),
Biological Station, Lunz am See (Austria).
For primary bibliographic entry see Field 2H.
W84-03510

NITRIFICATION IN THE RIVERS MOSELLE AND DANUBE (ZUR NITRIFIKATION IN MOSEL UND DONAU),
D. Mueller, and V. Kirchesch.
Archiv fur Hydrobiologie, Suppl. 68, No. 1, p 63-76, October, 1983. 4 Fig, 2 Tab, 17 Ref.

Descriptors: *Nitrification, *Moselle River, *Danube River, Ammonium, Water pollution effects, Biochemical oxygen demand, Dissolved oxygen, Bacteria.

Longitudinal profiles for the BOD-5 of the River Moselle and for the BOD-7 of the Danube demonstrate that the oxygen demand caused by nitrification is an important part of the BOD. The rate of nitrification in the Danube amounts to about 0.1 mg/l/day, which is a quarter of the rate in the Moselle, though the difference between the concentrations of ammonium in the two rivers is much higher (Moselle 2 mg/l, Danube 0.2 mg/l). The rates per volume of the nitrifying bacteria attached to the river bed are calculated to be 0.6 mg/l/day for the Moselle and 0.1 mg/l/day for the Danube. The significance of nitrification in the water development and management practice for the Moselle lies in its reducing effect on the concentration of ammonium and on the oxygen consumption. The decrease in oxygen content was of special importance because of its contribution to summer fish mortality. In the Danube nitrification prevents the enrichment in ammonium. (Baker-IVI)
W84-03511

SEASONAL AND LONG-TERM CHANGES IN THE HYDROBIOLOGY OF THE LAM TSUEN RIVER, NEW TERRITORIES, HONG KONG, WITH SPECIAL REFERENCE TO BENTHIC MACROINVERTEBRATE DISTRIBUTION AND ABUNDANCE,
Hong Kong Univ. Dept. of Zoology.
D. Dudgeon.
Archiv fur Hydrobiologie, Suppl. 69, No. 1, p 55-129, January, 1984. 38 Fig, 6 Tab, 146 Ref.

Descriptors: *Benthic environment, *Seasonal variations, *Lam Tsuen River, *Hong Kong, Species distribution, Macrobenthos, Bottom sediments, Eutrophication, Invertebrates, Aquatic animals.

Water quality varied along the river, with middle and lower course sites showing signs of slight cultural eutrophication in 1976. In 1978-79, the extent of organic enrichment of the river had increased at all but two upper reach stations. Temporal variations in water quality in 1978-79 were associated with changing river discharge resulting from Hong Kong's seasonal rainfall. The number of taxa and the diversity of macrobenthic communities decreased downstream in 1976 and 1978-79 while faunal abundance showed no such trend. The effects of increased cultural eutrophication in 1978-79 were reflected by large increases in macrobenthic population densities and a general decrease in faunal diversity. Lam Tsuen River sediments showed downstream changes in physical characteristics, tending towards decreased mean grain size, increased sorting and decreased skewness and kurtosis. The patterns of macroinvertebrate zonation, and sedimentary and hydrological characteristcis of the Lam Tsuen River, can be interpreted as reflecting transfers of material (nutrients, agricultural wastes, sewage) to the aquatic habitat from the surrounding terrestrial environment. Land use patterns around the Lam Tsuen River profoundly affec: aquatic communities through the medium of such transfers by altering community structure as well as the distribution and abundance of individual taxa. (Baker-IVI)
W84-03513

INVESTIGATIONS OF THE ECOTOXICOLOGICAL EFFECT OF A HERBICIDE IN AN AQUATIC MODEL ECOSYSTEM; II. FOOD CHAIN SIGNIFICANCE AND PESTICIDE BALANCE (UNTERSUCHUNGEN ZUR OKOTOXIKOLOGISCHEN WIRKUNG EINES HERBIZIDS IN EINEM AQUATISCHEN MODELLOKOSYSTEM; II. NAHRUNGSKETTENPROBLEME UND SCHADSTOFFBILANZIERUNG),
Technische Univ., Berlin (Germany, F.R.). Inst. fuer Technischen Umweltechutz.
For primary bibliographic entry see Field 5B.
W84-03514

ECOLOGICAL CHARACTERISTICS OF LAKES IN NORTH-EASTERN POLAND VERSUS THEIR TROPHIC GRADIENT; III. CHEMISTRY OF THE WATER IN 41 LAKES,
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland). Zaklad Hydrobiologii.
For primary bibliographic entry see Field 2H.
W84-03518

PRODUCTION OF A STREAM SHREDDER, PELTOPERLA MARIA (PLECOPTERA: PELTOPERLIDAE) IN DISTURBED AND UNDISTURBED HARDWOOD CATCHMENTS,
Georgia Univ., Athens. Dept. of Entomology.
J. O'Hop, J. B. Wallace, and J. D. Haefner.
Freshwater Biology, Vol. 14, No. 1, p 13-21, February, 1984. 2 Fig, 4 Tab, 36 Ref.

Descriptors: *Peltoperla maria, *Population density, *Streams, Ecosystems, Population dynamics, Catchment areas, Comparison studies, Appalachia, Insect behavior.

The average benthic density of Peltoperla maria in an undisturbed southern Appalachian stream was more than twice that of a nearby stream draining a previously clear-cut catchment in its tenth year of natural secondary succession. Peltoperla production estimates, using three methods, do not show a significant difference in production between streams draining the two catchments. This is attributed to quicker growth and slightly higher densities of larger nymphs in the disturbed stream. Production estimates for the disturbed stream ranged from 498 to 560 mg (ash free dry weight)/sq m/y while those for the undisturbed stream were 414-515 mg/sq m/y. These results reinforce the view that conclusions based solely upon numerical densities may lead to erroneous interpretations about the roles organisms play in ecosystems. Annual frass production by this shredder is about 20 times (10 g/sq m/y) the secondary production of P. maria. (Murphy-IVI)
W84-03528

LEVELS OF ORGANOCHLORINE COMPOUNDS IN AN INLAND SEAL POPULATION IN EASTERN FINLAND,
Joensuu Univ. (Finland). Dept. of Biology.
For primary bibliographic entry see Field 5B.
W84-03538

CHEMICAL AND HYDROLOGIC ASSESSMENT OF THE CALOOSAHATCHEE RIVER BASIN, LAKE OKEECHOBEE TO FRANKLIN LOCK, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 2E.
W84-03591

SOUTH JEFFERSON STREAM QUALITY ASSESSMENT PROGRAM,
Clarkson Coll. of Technology, Potsdam, NY. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W84-03654

ACID PRECIPITATION AND THE SALMON RIVER SYSTEM, TUG HILL, NEW YORK,
Clarkson Coll. of Technology, Potsdam, NY. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 2K.
W84-03658

TUG HILL REGION: PREPARING FOR THE FUTURE.
For primary bibliographic entry see Field 6G.
W84-03660

EFFECTS OF VOLCANIC ASH AND ESTUARINE SEDIMENT ON THE EARLY LIFE HISTORY STAGES OF THE PACIFIC HERRING, CLUPEA HARENGUS PALLASI,
Oregon State Univ., Newport. Marine Science Center.
G. W. Boehlert, J. B. Morgan, and M. M. Yoklavich.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84-153535, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Research Institute Publication WRRI-87, Oregon State Univ., Corvallis, October, 1983. 72 p, 13 Fig, 13 Tab, 52 Ref. Project No. OWRT C-10085-V (1461) (1), Contract/Grant No. 14-34-0001-1461.

Descriptors: *Volcanic ash, Fish, *Herring, *Pacific herring, *Fish eggs, *Fish larvae, Sedimentation, *Suspended solids, *Suspended sediment, Estuaries, *Estuarine fisheries, Fisheries, *Mt. St. Helens, *Columbia River Estuary.

Potential effects of volcanic ash from Mt. St. Helens eruption upon early life history stages of Pacific herring, Clupea harengus pallasi, a species which spawns demersal eggs in the lower Columbia River estuary, were assessed and compared with effects of uncontaminated estuarine sediment. Three life stages were considered: developing eggs, yolk-sac larvae, and newly feeding larvae. Settling of ash or sediment on developing eggs at increasing suspension concentrations slowed development and caused mortalities to approach 100%. Smothering due to oxygen deprivation was more dramatic with sediment than ash. Suspensions continuously maintained throughout incubation allowed a fine layer of sediment or ash to accumulate on eggs but did not affect mortality rates and development times. Newly hatched yolk-sac larvae were not affected by 24-hour exposure to suspensions. However, high suspension concentrations caused slight increases in mortality if larvae were subsequently held in clean water; abrasion appeared to be responsible and was greater with ash than sediment. Ash and sediment suspensions affected the feeding incidence and mean number of food items consumed by feeding larvae, apparently promoting feeding by providing contrast between prey items and surrounding water. Overall, volcanic ash and estuarine sediment at environmentally realistic suspension concentrations did not severely affect herring larvae. The greatest threat appears to be egg smothering and resultant increased mortality.
W84-03669

BIOACCUMULATION MONITORING IN THE NEW YORK BIGHT USING THE BLUE MUSSEL (MYTILUS EDULIS),
Army Engineer District, New York.
S. J. Koepp, D. E. Santoro, R. Zimmer, J. E. Nadeau, and L. Ciaccio.
Final Report, New Jersey Marine Sciences Consortium, March, 1982. 41 p, 1 Fig, 73 Ref, 9 Append.

Descriptors: *Bioaccumulation, *Tissue analysis, *Ocean dumping, *Contamination, *Mussels, *Mytilus, *Chemical wastes, *Bights, Harbors, Heavy metals, Lead, Petroleum hydrocarbons, Metals, Dredging.

Concern has been expressed for the New York Bight apex, adjacent to New York Harbor, regarding the environmental impact of ocean disposal of dredged material generated during routine harbor

maintenance. Contaminants such as chlorinated hydrocarbons, toxic metals and petroleum hydrocarbons have been detected in New York Harbor's dredged material as well as the six-mile dumpsite. A bioaccumulation monitoring study was conducted using blue mussels transplanted to eight New York Bight locations. Pooled tissue samples were analyzed for total concentrations of mercury, cadmium, lead, DDT, polychlorinated biphenyls (PCBs), and No. 2 fuel oil. Stations were sampled weekly for one month, after which bi-monthly mussel collections were conducted. Some stations were damaged due to storm and human activities. Throughout the study, DDT concentrations in mussels generally remained below analytical detection for all stations. Although the three metals (mercury, cadmium and lead), PCB, and the fuel oil were consistently detected at all stations, none of these contaminants were detected in excess of existing regulatory guidelines. Bioaccumulation of mercury and cadmium was significantly greater for animals exposed at the dredged material dumpside than at both immediate and distant reference stations. Higher levels of lead were also found near the dumpsite. Although net PCB bioaccumulation occurred at all stations, the pattern of uptake was erratic over time. No. 2 fuel oil accumulation had relatively minimal uptake during initial exposure, followed by a dramatic increase in early spring. (Garrison-Omniplan)
W84-03683

CA-45 UPTAKE FROM WATER BY SNAILS (LYMNAEA VULGARIS) IN CONTROL AND DETERGENT-POLLUTED SAMPLES,
Industrial Toxicology Research Centre, Lucknow (India).
V. Misra, H. Lal, P. N. Viswanathan, and C. R. Krishna Murti.
Ecotoxicology and Environmental Safety, Vol. 8, No. 1, p 97-99, February, 1984. 1 Fig, 1 Tab, 14 Ref.

Descriptors: *Detergents, *Water pollution effects, Snails, Aquatic life, Calcium, Mollusks, Adsorption.

Synthetic detergents are among the major pollutants affecting aquatic biota. A biostatic assay method involving Ca-45 uptake into shells and tissues of snails in 72 hr was developed in efforts to follow the effect of detergent-polluted water on ecosystems. A marked decrease in the Ca-45 uptake by shells (34.43%) and tissues (37.72%) of linear alkyl benzene sulfonate-exposed animals was noted. No change in Ca-45 uptake was observed in dead shells, thereby excluding the possibiliy of passive exchange. Detergent may possibly affect the active exchange of calcium by inhibiting the activity to carbonic anhydrase and reducing the rate of shell formation. (Baker-IVI)
W84-03706

EFFECTS OF TWO HERBICIDES ON SELECTED AQUATIC BACTERIA,
Illinois Natural History Survey, Champaign.
J. Beckmann, P. Tazik, and R. Gorden.
Bulletin of Environmental Contamination and Toxicology, Vol. 32, No. 2, p 243-250, February, 1984. 1 Fig, 1 Tab, 21 Ref.

Descriptors: *Herbicides, *Water pollution effects, *Bacteria, Aquatic life, Fate of pollutants, Simazine, Endothall.

Herbicide applications in aquatic systems may affect bacterial populations directly by either inhibiting or stimulating the metabolism of specific functional groups or of the entire community. The effects of simazine and endothall on bacterial populations in aquatic ecosystems were evaluated. Effects of endothall and simazine on growth and respiration of common bacterial isolates obtained from aquatic ecosystems were also studied. Neither herbicide had a significant effect on total bacterial numbers present in the water column, present in sediments, or attached to macrophytes. Endothall at 5 ppm apparently slightly inhibited the respiration rate of Micrococcus sp., slightly stimulated respiration of Pseudomonas vesicularis, and had no obvious effect on the respiration rate of Bacillus sp. Simazine at 3 ppm increased the respiratory activity of four isolates. (Baker-IVI)
W84-03711

ENVIRONMENTAL ASPECTS OF THE USE OF NTA AS A DETERGENT BUILDER,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
R. Perry, P. W. W. Kirk, T. Stephenson, and J. N. Lester.
Water Research, Vol. 18, No. 3, p 255-276, 1984. 10 Fig, 185 Ref.

Descriptors: *Nitrilotriacetic acid, *Detergents, *Heavy metals, Wastewater treatment, Biodegradation, Water pollution sources, Metal speciation, Sludge disposal, Water pollution sources.

The behavior, fate and significance of the detergent builder nitrilotriacetic acid (NTA) was reviewed with particular emphasis on the removal of NTA during wastewater treatment and the effects of NTA on heavy metal solubility both during treatment and in the receiving environment. NTA removal during secondary biological treatment is subject to considerable variation, both temporal and between works as a result of changes in NTA load, temperature, water hardness and treatment process parameters. Due to such variability, effluent NTA concentrations may be sufficient to mobilize heavy metals resulting in metal contamination of receiving waters and potable waters, particularly in areas of low effluent dilution and high water re-use. Removal of NTA during primary sedimentation and septic tank treatment occurs primarily by adsorption to the sludge solids while removal in anaerobic sludge digestion is subject to operational characteristics of the treatment works. Disposal of NTA contaminated sludge to land may contaminate groundwaters and affect heavy metal speciation, while the disposal of contaminated sludge or sewage to the sea may result in toxic algal blooms, in addition to the effects on metal speciation. (Baker-IVI)
W84-03730

EXCHANGE OF OXYGEN AND CARBON DIOXIDE ACROSS THE WATER SURFACE DURING ALGAL BLOOMS IN A POND,
Tokyo Univ. (Japan). Dept. of Chemical Engineering.
H. Nishimura, M. Nakajima, and M. Kumagai.
Water Research, Vol. 18, No. 3, p 345-350, 1984. 8 Fig, 18 Ref.

Descriptors: *Eutrophication, *Oxygen, *Carbon dioxide, Ponds, Algal growth, Algae, Gas exchange, Chlorophyll-a.

During algal blooms, total inorganic carbon (TCO2) is rapidly consumed through high photosynthetic activity of algae, and is often depleted to a trace in surface waters. Under these conditions, TCO2 may limit the algal growth rate. Measurements were taken of oxygen and total carbon dioxide, pH and chlorophyll-a as they related to the exchange of oxygen and carbon dioxide across the water surface of a pond during algal blooms. Light and dark bottles were also used to study the production and consumption rates of oxygen due to biological activity. Algal blooms occurred twice during the 22 day study period. The trajectory on the phase plane showing the time changes in concentration of oxygen and total carbon dioxide made a clockwise, converging loop. To distinguish the role of gas exchange from that of deposits, a new concept and quantity called total oxygen (TO2) is proposed. TO2 is the sum of the concentrations of O2 and TCO2. The total amount of TO2 decreased during the production period and increased during the decomposition period. This was due to the difference between O2 and TCO2. During the production period, 60% of produced O2 was lost to the atmosphere and 20% of consumed TCO2 was supplied from the atmosphere. During the decomposition period, 80% of consumed O2 was supplied, and 35% of produced TCO2 was lost. (Baker-IVI)
W84-03737

UPTAKE, DISTRIBUTION, METABOLISM AND CLEARANCE OF CHLORDECONE BY CHANNEL CATFISH (ICTALURUS PUNCTATUS),
Virginia Inst. of Marine Science, Gloucester Point.
P. A. van Veld, M. E. Bender, and M. H. Roberts, Jr.
Aquatic Toxicology, Vol. 5, No. 1, p 33-49, February, 1984. 2 Fig, 6 Tab, 38 Ref.

Descriptors: *Pesticides, *Water pollution effects, *Catfish, Fish, Chlordecone, Kepone, Adsorption, Accumulation, Metabolism, Path of pollutants.

Potential health and environmental hazard have arisen for the discharge of chlordecone (Kepone) into the upper tidal portion of the James River. Channel catfish were exposed to a C-14 labeled chlordecone-contaminated diet for 90 days, followed by a chlordecone-free diet for 30 days. Uptake and clearance rate constants were 0.237 and 0.080/day, respectively. The half-life of chlordecone in the fish was 8.7 days. The dietary accumulation factor defined as the equilibrium concentration of pesticide in fish/daily dietary dosage level was 3.0. The blood and brain contained the highest concentrations of chlordecone. Lowest concentrations were in the mesenteric adipose and carcass. Chlordecone may be eliminated with bile via the intestinal contents. It may also be excreted across the gills and sloughed off with epidermal mucus. Urinary excretion is negligible. The catfish can reduce chlordecone to chlordecone alcohol. Metabolic transformation of chlordecone by aquatic organisms has not previously been reported. Enzymatic digestion of bile with beta-glucuronidase did not significantly affect the recovery of chlordecone or chlordecone alcohol. (Baker-IVI)
W84-03742

ABUNDANCE, BIOMASS AND DIVERSITY OF BENTHIC MACRO-INVERTEBRATES IN A WESTERN CAPE RIVER, SOUTH AFRICA,
Cape Town Univ. (South Africa). Percy Fitzpatrick Inst. of African Ornithology.
For primary bibliographic entry see Field 2H.
W84-03751

COMMUNITY WATERBORNE GASTROENTERITIS OUTBREAK: EVIDENCE FOR ROTAVIRUS AS THE AGENT,
Colorado Dept. of Health, Denver. Disease Control and Epidemiology Div.
R. S. Hopkins, G. B. Gaspard, F. P. Williams, Jr., R. J. Karlin, and G. Cukor.
American Journal of Public Health, Vol. 74, No. 3, p 263-265, March, 1984. 1 Tab, 16 Ref. EPA contract CR-80880101.

Descriptors: *Public health, *Drinking water, *Water quality control, *Gastroenteritis, *Rotaviruses, Chlorination, Disinfection, Wastewater, Water pollution effects, Viruses, Eagle-Vail, Avon, Colorado.

A community waterborne nonbacterial gastroenteritis outbreak occurred in Eagle-Vail and Avon, Colorado in March of 1981. Eagle-Vail and Avon shared a common water supply and distribution system. Illness was statistically associated with water consumption. Five of seven persons associated with the outbreak were infected with rotavirus. Bacterial pathogens, Giardia lambia, and Norwalk virus were excluded as possibie agents. Four coincident physical factors probably contributed to the outbreak: a sewage treatment plant was discharging sludge solids into Gore Creek, upstream from the water intake for the Eagle-Vail water treatment plant; there was no chemical or physical pretreatment of water prior to filtration at the plant; severely channeled filter beds were found in the water treatment plant; and the Eagle-Vail chlorinator failed on March 4, 1981. This chlorinator was the only effective barrier between the toilets of Vail and the watertaps of Eagle-Vail and Avon. (Baker-IVI)
W84-03754

EVALUATION OF CHANGES IN A LARGE OLIGOTROPHIC WILDERNESS PARK LAKE EXPOSED TO MINE TAILING EFFLUENT FOR 14 YEARS: THE PHYTOPLANKTON,

Victoria Univ. (British Columbia). Dept. of Biology.
A. Austin, and N. Munteanu.

Environmental Pollution (Series A), Vol. 33, No. 1, p 39-62, 1984. 4 Fig, 5 Tab, 38 Ref.

Descriptors: *Water pollution effects, *Mine wastes, *Phytoplankton, Oligtrophic lakes, Buttle Lake, Upper Campbell Lake, Mercury, Zinc, Copper, Cadmium, Lead, Diatoms, Desmids, Upper Quinsam Lake, British Columbia.

Buttle Lake lies at the head of the extensive Campbell River watershed. Much of the drainage basin is located within the boundaries of Strathcona Provincial Wilderness Park. The lake connects by a narrow passage with Upper Campbell Lake which feeds into Lower Campbell Lake. Both Upper and Lower Campbell Lakes were formed from a river system by the construction of three dams. Mine tailings from a concentrator have been fed into Buttle Lake since 1967 via a submerged outfall. Data from phytoplankton samples collected in 1966, 1967, and 1968 were compared with data collected in 1980 and 1981. While the nutrient levels do not appear responsible, the levels of heavy metal concentrations have increased and reached values substantially above background levels in a control lake, Upper Quinsam Lake. Organisms intolerant of heavy metals, including several diatom and desmid species, have either disappeared or become extremely rare. Increases in abundance of Navicula cryptocephala, Synedra acus, S. ulna, Cyclotella bodanica and C. glomerata have been noted as these species are tolerant of the metal concentrations. These changes have resulted in a decrease in species diversity and species number. (Baker-IVI)
W84-03755

EFFECTS OF TRICHLOROETHYLENE ON THE POPULATION DYNAMICS OF PHYTO- AND ZOOPLANKTON IN COMPARTMENTS OF A NATURAL POND,

Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Okologische Chemie.
J. P. Lay, W. Schauerte, and W. Klein.

Environmental Pollution (Series A), Vol. 33, No. 1, p 75-91, 1984. 6 Fig, 2 Tab, 21 Ref. Commission of the European Communities Contract No. 187-77-1 ENV D.

Descriptors: *Zooplankton, *Population dynamics, *Water pollution effects, Ponds, Trichloroethylene, Organic compounds, Trophic levels.

Single doses (110 and 25 mg/liter) of trichloroethylene (Tri) were applied in replicates to the water of compartments of a natural pond. In comparison to two control compartments and the surrounding water, the disappearance rates of Tri and the effects on the biota were measured. Disappearance rates of Tri from the aquatic phase were equal for both chemical concentrations and were determined at a half-life of 2.7 days. Both initial concentrations of Tri were highly toxic to Daphnia and caused a decrease (low dose) or elimination (high dose) of this species shortly after application. Following Tri application the phytoplankton community changes from high to low diversity. Relative abundance and the absolute number of all phytoplankton individuals counted increased, mostly in the high-dosed compartments. Autotrophic phytoplankton species were eliminated in part, heterotrophic ones significantly increased. Physicochemical properties of the water were not significantly influenced by the treatment. (Baker-IVI)
W84-03756

RECOVERY OF DDT, KEPONE, AND PERMETHRIN ADDED TO SOIL AND SEDIMENT SUSPENSIONS INCUBATED UNDER CONTROLLED REDOX POTENTIAL AND PH CONDITIONS,

Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
R. P. Gambrell, C. N. Reddy, V. Collard, G. Green, and W. H. Patrick, Jr.

Journal Water Pollution Control Federation, Vol. 56, No. 2, p 174-182, February, 1984. 8 Fig, 2 Tab, 15 Ref. EPA Grant R804940-01-1.

Descriptors: *Pesticides, *Fate of pollutants, *Environmental effects, Permethrin, DDT, Kepone, Chemical reactions, Organic compounds.

The persistence and fate of organic pesticides and therefore their environmental impact differs widely under various physicochemical conditions. Permethrin can be strongly affected by physicochemical conditions of the environment during the course of a few weeks to a few months. Strongly reducing conditions characteristic of sediments enhance the persistence of Permethrin. The effects of pH on recovery of DDT from amended sediment material were negligible at each of the four redox potential levels studied. Redox potential treatments, however, greatly affected DDT recovery. At all redox potentials used there was no evidence of any reduction in Kepone levels during the 52 day study. At pH levels of 5.0 and 8.0 there was some evidence of a decrease in Kepone concentrations toward the end of incubation (51 and 70 days, respectively), but any degradation, if it occurred, was masked by experimental variability encountered in the incubation conducted at these two pH levels. At all pH levels, there was no good indication that oxidation-reduction conditions affected Kepone degradation. Strongly reduced environs of many sensitive benthic species favor some increase in the persistence of residues that may adversely affect these populations. (Baker-IVI)
W84-03795

MEASUREMENT OF BENTHAL OXYGEN DEMAND IN THE HOUSTON SHIP CHANNEL,

Espey, Huston and Associates, Inc., Austin, TX.
G. H. Ward, Jr.

Journal Water Pollution Control Federation, Vol. 56, No. 2, p 183-191, February, 1984. 5 Fig, 1 Tab, 24 Ref.

Descriptors: *Benthos, *Oxygen demand, *Harbors, *Houston Ship Channel, Texas, Channels, Respirometer, San Jacinto River, Turning Basin, Temperature effects, Water pollution effects.

The Houston Ship Canal is a dredged canal from the entrance of Galveston Bay to the Port of Houston within the San Jacinto River System across the bay. The upper reach is highly developed, and includes several municipal treatment plants and the bulk of the Houston petrochemical complex. There is a substantial wastewater return in this reach and it is a region of consistently poor water quality. Respirometers developed in this study seem to be a useful method for direct measurement of the potential oxygen demand of Houston Ship Channel sediments. The homogenate BOD6 (HBOD6) test appears to be a satisfactory, economical indicator of large scale, intensive surveys of benthal oxygen demand. The potential benthal oxygen demand varied from 0.7 to 4.2 g/sq m/day, generally increasing with distance up the channel from the San Jacinto confluence toward the Turning Basin. Nitrification did not play any role in the oxygen depletion of samples in this study. The addition of methylene blue produced no systematic alteration in benthal oxygen demand. (Baker-IVI)
W84-03796

MERCURY AND POLYCHLORINATED BIPHENYLS IN STRIPED BASS (MORONE SAXATILIS) FROM TWO NOVA SCOTIA RIVERS,

Department of Fisheries and Oceans, St. Andrews (New Brunswick).
S. Ray, B. M. Jessop, J. Coffin, and D. A. Swetnam.

Water, Air, and Soil Pollution, Vol. 21, No. 1-4, p 15-23, January, 1984. 1 Fig, 5 Tab, 28 Ref.

Descriptors: *Water pollution effects, *Bass, *Annapolis River, *Shubenacadie River, *Nova Scotia, *Mercury, *Polychlorinated biphenyls, Organic compounds, Heavy metals, Toxicity, Fisheries.

The striped bass fishery in the Annapolis and Shubenacadie Rivers of Nova Scotia is of sport and commercial importance. In recent years, the striped bass have not reproduced successfully in the Annapolis River, whereas they have no recruitment problem in Shubenacadie River. Striped bass were obtained from the angling fishery in the Annapolis River and from both angling and commercial fisheries of the Shubenacadie River in Nova Scotia, Canada. Analyses were performed for mercury content in four tissues and for PCBs in two tissues. The average mercury concentrations in the muscle, liver, kidney, and gonad of 3.9 kg fish from the Annapolis River were 0.77, 0.79, 0.26, and 0.07 micrograms/g, respectively. Corresponding values for the 1.5 kg fish from the Shubenacadie River were 0.51, 0.27, 0.24, and 0.06 micrograms/g. PCB concentrations in the muscle tissues of fish from Annapolis and Shubenacadie Rivers are 0.02 and 0.01 micrograms/g, respectively, while the concentrations in gonads are 1.4 and 0.04 micrograms/g. The observed lack of stock recruitment of striped bass in the Annapolis River may be related to high PCB concentrations in the gonad tissues. (Baker-IVI)
W84-03828

VARIATIONS IN SURFACE WATER PH WITH CHANGES IN SULPHUR DEPOSITION,

Sentralinstitutt for Industriell Forskning, Oslo (Norway).
H. M. Seip, and S. Rustad.

Water, Air, and Soil Pollution, Vol. 21, No. 1-4, p 217-223, January, 1984. 2 Fig, 2 Tab, 7 Ref.

Descriptors: *Acidity, *Lakes, *Acid rain, *Hydrogen ion concentration, Precipitation, Sulfates, Sulfur, Water pollution sources, Aluminum, Birkenes catchment, Norway.

The effects on surface water acidity brought about by a doubling of the sulfate concentration in runoff are considered. A very simple two reservoir hydrological model was used in the calculations. The upper reservoir supplies quickflow and can be thought of as water mainly in contact with upper soil horizons. The lower reservoir provides the base flow. It was found to be a useful approximation for the Birkenes catchment in southernmost Norway, but this is not necessarily true for most other catchments. A possible refinement of this approach would call for inclusion of other substances. Aluminum species and organic acids would give increased buffering intensities. Doubling of the sulfate concentrations in the runoff in this study may in some cases give pH decreases of 0.7 to 1.0 units or even more, from about 6 to about 5, assuming no changes in soil properties, such as base saturation, occurred. (Baker-IVI)
W84-03833

SYNERGISTIC EFFECTS OF HEAVY METAL POLLUTANTS ON SENESCENCE IN SUBMERGED AQUATIC PLANTS,

Burdwan Univ. (India). Plant Physiology and Biochemistry Lab.
S. Jana, and M. A. Choudhuri.

Water, Air, and Soil Pollution, Vol. 21, No. 1-4, p 351-357, January, 1984. 4 Tab, 6 Ref.

Descriptors: *Water pollution effects, *Heavy metals, *Plant growth, Mercuric chloride, Lead acetate, Cadmium chloride, Cupric sulfate, Aquatic plants, Potamogeton, Vallisneria, Hydrilla, Bioindicators.

Water pollution by industrial wastes containing compounds of various heavy metal pollutants disturbs the vegetation in aquatic habitats. The sensitivity to a specific combination of toxic concentrations of heavy metal pollutants may differ for different species and it may be possible to exploit the differences in sensitivity to select indicator species for water pollution. The effects of many combinations of toxic concentrations of heavy metal pollutants, viz., mercuric chloride, lead acetate, cadmium chloride and cupric sulfate, on the

senescence of isolated mature leaves of submerged aquatic plants, Potamogeton pectinatus L., Vallisneria spiralis L., and Hydrilla verticillata (L.f.) Royle were studied. All of the combinations of heavy metal pollutants caused senescence in all three species by decreasing chlorophyll, DNA, RNA, protein and dry wt, and increasing free amino acid, tissue permeability, the activities of protease and RNase, and the ratio of acid to alkaline pyrophosphatase activity over control values. The effects were highest in Potamogeton and lowest in Hydrilla. The degree of senescence in the three submerged plants by combinations of toxic concentrations of heavy metal pollutants is much higher due to synergism than that by individual heavy metal pollutants. (Murphy-IVI)
W84-03837

ALTERATIONS IN CARBON FIXATION DURING POWER PLANT ENTRAINMENT OF ESTUARINE PHYTOPLANKTON,

Academy of Natural Sciences of Philadelphia, Benedict, MD. Benedict Estuarine Research Lab.
K. G. Sellner, M. E. Kachur, and L. Lyons.
Water, Air, and Soil Pollution, Vol. 21, No. 1-4, p 359-374, January, 1984. 10 Fig, 5 Tab, 18 Ref.

Descriptors: *Powerplants, *Phytoplankton, *Carbon fixation, *Entrainment, Phytoplankton population, Population densities, Dinoflagellates, Diatoms, Carbon, Estuarine environment, Estuaries.

The entrainment of estuarine waters in the cooling units of the Calvert Cliffs Nuclear Power Plant resulted in elevated productivities in June and reductions in C fixation rates for the total phytoplankton assemblages in July through September. In the latter 3 months, the passage of Bay water through the plant was accompanied by a decline in the photosynthetic activity of the microflagellate, Cryptomonas acuta. Phytosynthetic rates of the diatom Cyclotella and Thalassionema and the dinoflagellate Prorocentrum were not significantly altered by passage through the power plant. Assuming other representatives of each phyla respond in a similar manner, depressed phytoplankton productivity in entrained Bay waters would be expected when flagellates (as unidentified microflagellates and cryptophytes) dominate the phytoplankton assemblage and the entrainment temperature exceeds 30 degrees C. (Baker-IVI)
W84-03838

ENVIRONMENTAL FECAL POLLUTION AND CONCENTRATION POWER OF THE CLAM CHAMELEA GALLINA,

Istituto Superiore di Sanita, Rome (Italy).
L. Volterra, G. Piccininno, E. Palliola, F. A. Aulicino, and M. Gianfranceschi.
Water, Air, and Soil Pollution, Vol. 21, No. 1-4, p 415-424, January, 1984. 4 Tab, 23 Ref.

Descriptors: *Water pollution effects, *Clams, *Bacteria, Microorganisms, Sewage bacteria, Wastewater, Italy.

Hygienic conditions of a commercially important clam, Chamelea (Venus) gallina, widely distributed along the Italian coasts were examined, with particular interest paid to whether these clams, inside their valves, accumulate microorganisms and pathogens which are present in marine sediments, directly carried into the sea by sewers, indirectly by rivers and canals. The habitat of C. gallinas is the sediment of shallow waters, from 4 to 6 m. In Italy, these depths may be located at about 200 up to 1000 m from the coastline. Five clam beds have been simultaneously surveyed, collecting samples of water, sediment and mollusks. Four extensive clam banks in the Adriatic sea (Chioggia, Goro, Rimini, Cupra Marittima) and a bank recently discovered in the Tyrrhenian sea at Caprolace were sampled. Total coliforms, fecal coliforms, and fecal streptococci have been analyzed. Results indicate that this shellfish does not seem to accumulate enteric bacteria in spite of the microbial contamination of water and sediment. (Baker-IVI)
W84-03840

EFFECTS OF VOLCANIC ASH ON THE BENTHIC ENVIRONMENT OF A MOUNTAIN STREAM, NORTHERN IDAHO,

Geological Survey, Boise, ID. Water Resources Div.
S. A. Frenzel.
Available from the Ofss, USGS, Lakewood, CO 80225, Price: $4.75 in paper copy, $3.50 in microfiche. USGS Water-Resources Investigation Reports 82-4106, Jan. 1983. 32 p, 6 Fig, 6 Tab, 26 Ref.

Descriptors: *Stream, *Environment, Habitats, *Water quality, Benthos, *Sediments, *Idaho, Big Creek, Gedney Creek, Volcanic ash.

The May 18, 1980, eruption of Mount St. Helens deposited about 15 millimeters of volcanic ash on the Big Creek basin in northern Idaho. Much of the uncompacted ash remained on hillsides a year after the eruption. Physical and chemical analyses of water samples from Big Creek collected from December 1980 to December 1981 showed no anomalies attributable to ash. Qualitative collections showed benthic invertebrates to be abundant and diverse in Big Creek. Experiments conducted in an unimpacted mountain stream revealed a small quantity of volcanic ash may be beneficial not detrimental to invertebrate communities. Benthic invertebrates were most abundant on ash-covered artificial substrates, with detritovores dominating the communities on all substrates. (USGS)
W84-03854

POLLUTED GROUNDWATER CLEARLY A PROBLEM, BUT FEW AGREE ON EXTENT OR SOLUTION,

L. Mosher.
National Journal, Vol. 16, No. 5, p 223-225, February, 1984.

Descriptors: *Groundwater pollution, *Federal jurisdiction, Environmental Protection Agency, Management, Political aspects, Water pollution sources, Land use, Waste dumps.

Contamination threatens the underground water supply of the United States. A chief source of the pollution is land-related, being the runoff from farms and cities, which contains a rich brew of synthetic organic toxic chemicals, most of which do not break down in the ground. Regulating land use is primarily a state responsibility that the federal government cannot directly interfere with. After a change in leadership at the EPA last May, a revision of that department's approach to groundwater pollution control was expected. Under a new plan, states are given the primary responsibility to protect groundwater, but the agency would attempt to use the 1976 Toxic Substances Control Act to regulate underground storage tanks, which it considers a major contamination course. Three classes of groundwater would be distinguished, each with its own level of protection required. Some have expressed disappointment with the new plan, indicating it is little more than a public relations move. One impoundment study reportedly found 180,973 waste ponds around the country, almost half of which were over aquifers, and only 30% of which have protective liners. (Baker-IVI)
W84-03869

FATE AND EFFECTS OF ATRAZINE IN SMALL AQUATIC MICROCOSMS,

Environmental Research Lab., Athens, GA.
D. L. Brockway, P. D. Smith, and F. E. Stancil.
Bulletin of Environmental Contamination and Toxicology, Vol. 32, No. 3, p 345-353, March, 1984. 4 Fig, 10 Ref.

Descriptors: *Water pollution effects, *Herbicides, Atrazine, Aquatic life, Organic compounds, Agricultural chemicals, Fate of pollutants.

The objectives of this study were to determine the fate and effects of atrazine on small laboratory microcosms, to evaluate the resilience of the systems after removal of the atrazine, and to compare the responses of different types of test systems to the herbicide. This study was carried out with mixed biota communities in either continuous-flow aquaria or static beakers. Atrazine concentrations of 0, 0.5, 5, and 50 micro g/l were introduced into the continuous-flow aquaria. The experiments in the static beakers tested concentrations of 0 to 5000 micro g/l. The degradation and sorption of atrazine was very low in aquatic systems. Atrazine had a negative impact on primary producers at and above a concentration of 50 micrograms/L and possibly below. These effects are expressed best in oxygen production and dissolved nitrate in the systems. The small static systems are able to furnish results similar to those of larger more complex systems, particularly for quick response parameters. (Baker-IVI)
W84-03878

EFFECTS OF CRUDE DUBAI OIL ON SALMO GAIRDNERI RICH. AND CARASSIUS AURATUS L.,

Milan Univ. (Italy). Sezione di Ecologia.
M. C. Ramusino, R. Dellavedova, and D. Zanzottera.
Bulletin of Environmental Contamination and Toxicology, Vol. 32, No. 3, p 368-376, March, 1984. 5 Fig, 2 Tab, 6 Ref.

Descriptors: *Water pollution effects, *Oil spills, *Fish, Toxicity, Po River, Italy, Dubai oil, Organic compounds, Carassius, Salmo.

About 663 tons of crude Dubai oil poured into the river Po, the largest Italian river in 1980 as a result of a burst oil pipeline. Laboratory tests were carried out to identify the lethal concentrations and the concentration threshold value (below which mortality does not occur) for crude Dubai oil. Tests on Carassius auratus, treated with Dubai crude undiluted, resulted in a 48 hr LC50 of 19.89 ml/L. In tests with the water soluble fraction (WSF) of crude Dubai, an initial phase of acute toxicity was present during which mortalities occurred. However, for those animals who survived this initial phase, complete recovery was apparent. This suggests the presence of a fairly toxic volatile component which causes the acute initial effects and then evaporates. Tests using Salmo gairdneri indicate that this organism is extremely sensitive to this form of pollution. Even so, differences were evident in the response to crude oil and to its WSF. (Baker-IVI)
W84-03879

LEAF LITTER BREAKDOWN IN STREAMS RECEIVING TREATED AND UNTREATED METAL MINE DRAINAGE,

Colorado State Univ., Fort Collins. Dept. of Zoology and Entomology.
L. J. Gray, and J. V. Ward.
Environment International, Vol. 9, No. 2, p 135-138, 1983. 2 Fig, 14 Ref.

Descriptors: *Litter, *Mine drainage, Organic matter, Streams, Colorado, Iron, Metals, Decomposition, Water pollution effects.

Because of its importance in the flow of energy in streams, leaf decomposition provides an ecosystem-level measure of pollution effects. Rates of alder leaf decomposition were used as a measure of effects of untreated and treated acid mine drainge on two Colorado mountain streams. The two study streams were Kerber Creek, a third-order tributary of San Luis Creek, and Coal Creek, a third-order tributary of the Slate River. Untreated mine effluents had low pH and high concentrations of metals, particularly iron. Deposition of ferric hydroxide on leaf surfaces inhibited colonization by decomposers, such as fungi and aquatic insects, and thus little leaf breakdown occurred. Treated effluents had improved water quality (basic pH, low metal concentrations), but suspended flocs released by the treatment process buried leaves and reduced consumer activity. The rate of leaf breakdown was not significantly different from the rate with untreated effluents. Thus improvement in water quality alone was insufficient to restore this important pathway of energy flow in headwater streams. (Baker-IVI)
W84-03889

TCDD DISTRIBUTION IN THE SPRING RIVER, SOUTHWESTERN MISSOURI,
Environmental Protection Agency, Kansas City, MO. Region VII.
R. D. Kleopfer, and J. Zirschky.
Environment International, Vol. 9, No. 4, p 249-253, 1983. 1 Fig, 1 Tab, 13 Ref.

Descriptors: *Water pollution effects, *Spring River, *Missouri, *Fish, *Sediments, *TCDD, Dioxins, Biological magnification, Industrial wastes, Waste disposal.

The waste management practices of a chemical company (no longer in business) created several disposal sites containing materials contaminated with TCDD, 2,3,7,8-tetrachlorodibenzo-p-dioxin. The facility manufactured hexachlorophene from tetrachlorobenzene with 2,4,5-trichlorophenol (TCP) produced as an intermediate. TCDD was formed as an unwanted trace contaminant of the TCP. A sampling survey of the Spring River, which drains the disposal sites, was conducted to determine if TCDD contamination had occurred. Levels detected in the upper reaches of the river tend to indicate that the contamination of the river has resulted from the waste management practices of the former company. Fish contamination above the point in the stream where pollution could enter the water could be explained by migration of the fishes. Two dams near Carthage, MO were expected to prevent sediment migration beyond that point and thus limit fish contamination to areas upstream of the dams. Contaminated fish were found for a distance of at least 21 miles beyond the dams, which were not physical barriers to fish movement in either direction. Bioconcentration of extremely low levels of TCDD from the aqueous phase may also explain the extent of the contamination. The detection limits were not sufficient to determine the sediment TCDD concentration in the river. TCDD was only found in sediments immediately downstream of the former manufacturing facility at 12 ng/kg. (Baker-IVI)
W84-03891

EVALUATING THE CONSTRAINTS OF TEMPERATURE, ACTIVITY AND CONSUMPTION ON GROWTH OF LARGEMOUTH BASS,
Wisconsin Univ.-Madison. Lab. of Limnology.
J. A. Rice, J. E. Breck, S. M. Bartell, and J. F. Kitchell.
Environmental Biology of Fishes, Vol. 9, No. 3/4, p 263-275, 1983. 9 Fig, 1 Tab, 42 Ref. Savannah River Ecology Laboratory project 18449; Oak Ridge Associated Univ. Travel contract T-289; EPA and Department of Energy contract EPA-78-D-X0290; Univ. of Georgia and Department of Energy contract EY-79-A-09-0943.

Descriptors: *Bass, *Growth, Temperature effects, Fish diets, Bioenergetics, Fish behavior, Thermal pollution, Model studies, Growth model, Simulation analysis, Par Pond, South Carolina.

Growth represents a complex response to a variety of environmental factors. Bioenergetics modeling is an efficient means of evaluating the relative importance of these variables. A bioenergetics model for largemouth bass (Micropterus salmoides) simulates growth as a function of body size, temperature, activity and consumption level . The model is applied to bass in Par Pond, South Carolina, a reservoir receiving heated effluent, to investigate seasonal changes in condition factor. Previous authors have suggested that these changes occur due to bioenergetic constraints, primarily the effects of heated effluent on metabolic rate. Model simulations were used to evaluate the hypotheses that seasonal changes in condition factor were caused by the heated effluent, seasonally variable activity, seasonally variable consumption, or reproductive costs. Results indicate that temperature is not directly responsible for the seasonal changes in condition factor. Bass moderate the influence of the heated effluent via behavioral thermoregulation. Activity is not a major factor, and spawning weight-loss can account for only a small portion of the observed variation. However, the pattern of seasonal changes in body condition may be adequately explained by seasonal variations in consumption. The patterns of consumption rate and/or prey availability suggested by model simulations represent testable hypotheses. (Murphy-IVI)
W84-03895

ACIDIC PRECIPITATION EFFECTS ON CROPS: A REVIEW AND ANALYSIS OF RESEARCH,
Argonne National Lab., IL.
P. M. Irving.
Journal of Environmental Quality, Vol. 12, No. 4, p 442-453, 1983. 2 Fig, 2 Tab, 34 Ref.

Descriptors: *Acid rain, *Literature review, Environmental effects, Crop yield, Air pollution effects, Air pollution, Deposition, Simulated rain, Acidic deposition.

For more than a century it has been known that vegetative growth is affected by the products of fossil fuel combustion. Recently, the acidic deposition phenomenon has gained increasing attention, especially when implicated as a factor responsible for economic loss. Research has been directed toward quantification of effects; however, limitations in the design of many crop studies restricts the usefulness and applicability of the results. Acidic deposition varies in a number of ways that may affect crop yield (i.e., level of acidity, amount and intensity of rain, S and N doses). The responses of these variables may be nonlinear. To allow comparisons of published acid precipitation effects research, calculations for this review were made (based on information in the literature or from personal communication) to describe the experimental conditions, the various dose parameters, and the responses in comparable units for each investigation. The majority of crop species studied in field and controlled environment experiments exhibited no effect on growth nor yield as a result of simulated acidic rain. The growth and yield of some crops, however, was negatively affected by acidic rain; others exhibited a positive response. This analysis of the current literature concludes that the effects of acidic precipitation on crops appear to be minimal and that when responses are observed, they may be positive or negative. More complex experimental designs and analyses may be necessary in order to examine and describe the possible subtle responses of agricultural systems to acidic precipitation. (Author's abstract)
W84-03925

EFFECTS OF ACIDITY AND ALKALINITY ON THE STABILITY OF AMIDOHYDROLASES IN FRESHWATER,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
W. T. Frankenberger, Jr., and A. L. Page.
Journal of Environmental Quality, Vol. 12, No. 4, p 459-462, 1983. 5 Fig, 1 Tab, 13 Ref.

Descriptors: *Acidic water, *Alkalinity, *Amide-N, *Enzymatic hydrolysis, L-asparaginase, L-glutaminase, Amidase, Urease, Hydrogen ion concentration, Lakes, Cycling nutrients, Organic compounds, Microbial degradation.

The influence of acidity and alkalinity on the enzymatic hydrolysis of amide-N in the aquatic system was investigated by determining the stability of L-asparaginase (EC (Enzyme Commission) 3.5.1.1.), L-glutaminase (EC 3.5.1.2.), and amidase (EC 3.5.1.4.), and urease (EC 3.5.1.5.) with respect to pH in three freshwater lakes. The water samples were first incubated at the indicated buffer pH (1-13) for 24 h; then each enzyme was assayed at its optional pH (pHopt) under standardized conditions. L-Asparaginase retained essentially 100% of its activity within the pH range of 6-7 in Lake Evans and Lake Matthews, and 5-7 in Lake Perris. L-Glutaminase was active between pH 6 and 7 in the water samples surveyed. Amidase remained completely active at pH ranges of 4-8 in Lake Evans, 4-7 in Lake Matthews, and 5-8 in Lake Perris. Urease remained active over a broad pH range of 5-9 in Lake Evans, 5-8 in Lake Matthews, and 4-8 in Lake Perris. There was a progressive loss in enzymatic activity below and above these pH ranges. The results suggest that the decline in aquatic amidohydrolase activities in relation to the pH-profile near their pHopt was caused by a reversible reaction involving the ionization or deionization of functional groups of the active center of the protein, but under highly acidic or alkaline conditions (pH < 4 to > 9) the reduced activity appears to be due to irreversible inactivation of the enzyme. (Author's abstract)
W84-03926

RESPONSE OF SOYBEANS TO SIMULATED ACID RAIN IN THE FIELD,
North Carolina State Univ. at Raleigh. Dept. of Plant Pathology.
A. S. Heagle, R. B. Philbeck, P. F. Brewer, and R. E. Ferrell.
Journal of Environmental Quality, Vol. 12, No. 4, p 538-543, 1983. 1 Fig, 3 Tab, 19 Ref.

Descriptors: *Ecological effects, *Soybeans, *Simulated rainfall, *Acid rain, Crop yield, Soil chemistry, Hydrogen ion concentration, Rhizobium nodulation, Nematodes.

Soybeans, Glycine max (L.) Merr, 'Davis', were grown in the field during 1979 and 1980 to determine effects of semiweekly applications of simulated rain at different acidity levels in addition to ambient rain on foliage, growth, yield, Rhizobium nodulation, soil chemistry, and soil nematode populations. Plants were exposed twice weekly to 0.74 cm (1979) or 0.85 cm (1980) of simulated rain at pH levels of 5.5, 4.0, 3.2, or 2.8 in 1979 and 5.4, 4.1, 3.2, or 2.4 in 1980. There were six 3-sq m plots (replicates) for each pH level. Simulated rain at pH 2.8 or 2.4 caused small amounts of foliar injury evident as bifacial white or tan lesions primarily on young leaves. However, plant growth, pod yield, foliar elemental content, seed protein content, seed oil content, Rhizobium nodulation of roots, and populations of parasitic nematodes were not affected. Soil analyses were performed before, midway through, and after each season. Trends toward lower soil pH, and less Ca, Mg, and K occurred with increased acidity of simulated rain. These effects were statistically significant only for soil pH, Mg, and K at treatment pH 2.4. Possible effects of ambient rain at current pH levels on agricultural soils are likely to require long-term deposition. (Murphy-IVI)
W84-03932

EFFECT OF FOUR TERRESTRIAL HERBICIDES ON THE PRODUCTIVITY OF ARTIFICIAL STREAM ALGAL COMMUNITIES,
Texas A and M Univ., College Station. Dept. of Soil and Crop Sciences.
R. J. Kosinski, and M. G. Merkle.
Journal of Environmental Quality, Vol. 13, No. 1, p 75-82, 1984. 4 Fig, 2 Tab, 54 Ref. EPA grant 807978-01.

Descriptors: *Ecological effects, *Herbicides, *Algae, *Artificial streams, Streams, Atrazine, Trifluralin, Monosodium methanearsonate, Paraquat, Water pollution, Primary productivity.

Artificial streams containing algal communities derived from a spring and an agriculturally impacted stream were used to assess the effect of 0.1, 1, and 10 mg/kg atrazine 2-chloro-4-(ethylamino)-6-(isopropylamino)-s-triazine, trifluralin (alpha, alpha, alpha-trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine), MSMA (monosodium methanearsonate), and paraquat (1,1'-dimethyl-4,4'-bipyridylium cation) on the productivity (photosynthesis and respiration) of stream algae. Algae of streams receiving runoff from agricultural lands are an obvious nontarget community. The importance of induced resistance to the herbicides was evaluated by comparing the responses of the spring and stream algae and by determining if allowing the streams to be colonized for 3 weeks in the presence of 0.01 mg/kg of the herbicide under test would modify response by selecting for a more resistant flora. Productivity was measured by open-water oxygen methods for 3 weeks before and 3 weeks after herbicide injection. The communities derived from both the spring and the stream were dominated by diatoms, and responded similarly to trifluralin, atrazine, and MSMA, but had divergent re-

sponses to paraquat. Trifluralin had no effect on productivity. Photosynthesis was significantly depressed by 1 and 10 mg/kg atrazine and by 10 mg/kg MSMA, and there were indications of a slight inhibition by 0.01 mg/kg atrazine. Paraquat at 10 mg/kg had little effect on the spring-derived communities but caused severe inhibition of the stream-derived algae. There was little evidence that exposure to 0.01 mg/kg herbicide during colonization modified the response of the algae to any of the herbicides. (Murphy-IVI)
W84-03938

BENTHOS OF A MARINE FLY-ASH DUMPING GROUND,
Newcastle upon Tyne Univ. (England). Dove Marine Lab.
R. N. Bamber.
Journal of the Marine Biological Association of the United Kingdom, Vol. 64, No. 1, p 211-226, February, 1984. 12 Fig, 1 Tab, 30 Ref.

Descriptors: *Water pollution effects, *Fly ash, *Benthic environment, *England, *Northumberland, *Coastal waters, Sediments, Aquatic animals, Powerplants, Industrial waste, Species diversity.

Blyth Power Station, in Northumberland, England is a 1548 MW coal-fired station complex, burning about 16,000 tons of coal per day, resulting in an annual dumping of one million tons of pulverized fuel ash (fly ash) off the adjacent coast. The benthic fauna of the fly-ash dumping ground off the coast was compared with that of the surrounding natural sediments and a designated offshore spoil ground. The silt fraction of the sediments increased as a result of continued ash dumping. The appearance of pozzolanic aggregates at the sites of greatest dumping also occurred, some 3.5 km offshore. The natural benthic macrofauna represented a typical Echinocardium-filiformis community, giving way throughout the offshore spoil ground to a Paraonis-Magelona community dominated by smaller polychaete species more tolerant of poor sediments. An anomalous community structure was evident at the stations at the center of the ash dumping. The density of the fauna was reduced at the center of the ash dumping, the worst station yielding only eight individuals in 0.2 sq m. Contours of numbers of macrofaunal individuals and species, of faunistic diversity and biomass, and of meiofaunal numbers all show a similar pattern of some depression along the spoil ground, and greater depression at the ash-dumping center. A negative correlation between faunistic parameters and ash content was confirmed by statistical analyses. Deposit-feeding species represented a lower proportion of the community at sites of high ash content. The negative correlation between faunistic diversity and ash content was statistically significant over an area of 43 sq km around the center of the dumping. The faunistic impoverishment is considered to be a response to the dumping. (Baker-IVI)
W84-03959

24-H CHANGES IN CHLOROPHYLL CONTENT OF PHYTOPLANKTON OF LAKE JELONEK, AS COMPARED WITH THE PHYSICAL AND CHEMICAL PROPERTIES OF WATER,
Poznan Technical Univ. (Poland). Inst of Environmental Engineering.
J. Panczakowa, and T. Szyszka.
Polskie Archiwum Hydrobiologii, Vol. 30, No. 3, p 207-227, 1983. 11 Fig, 3 Tab, 16 Ref.

Descriptors: *Chlorophyll, *Phytoplankton, *Lake Jelonek, *Poland, Phosphorus, Nitrogen, Nutrients, Eutrophication, Algal growth, Dissolved oxygen, Carbonates, Hydrogen ion concentration, Aphanizomenon, Volvox, Melosira.

Measurements were taken in 1979 in the strongly eutrophic polymictic Lake Jelonek of 24-hr changes in the chlorophyll concentration, quality and quantity of phytoplankton and the chemical composition of seston as compared with the physical and chemical properties of water. Three different developmental phases of Aphanizomenon flos-aquae were studied. In June during bloom dying, in addition to Aphanizomenon flos-aquae, Volvox aureus was present, though in small number. In July, during a subsequent increase in the population of Aphanizomenon flos-aquae, relatively large numbers of Melosira granulata occurred. In August the Aphanizomenon flos-aquae predominated. In June, during the dying of the blue-green algae bloom, concentrations of dissolved oxygen and carbonate as well as the pH of water steadily decreased. The chlorophyll content continually fluctuated. In July and August, the chlorophyll content was greatest during the day. In the period of dominance of one species, the numbers of phytoplankton organisms, chlorophyll content, dissolved oxygen concentration and BOD-5 were all evidently related. Phosphorus and nitrogen showed no clear-cut 24-hr changes. (Baker-IVI)
W84-03988

ACTIVITY OF BENZO(A)PYRENE MONOOXYGENASE IN FISH FROM THE SAVA RIVER, YUGOSLAVIA: CORRELATION WITH POLLUTION,
Institut Rudjer Boskovic, Zagreb (Yugoslavia).
N. Kezic, S. Britvic, M. Protic, J. E. Simmons, and M. Rijavec.
The Science of the Total Environment, Vol. 27, No. 1, p 59-69, March, 1983. 1 Fig, 7 Tab, 24 Ref.

Descriptors: *Effects of pollution, *Fish, *Sava River, *Yugoslavia, Benzo(a)pyrene, Enzymes, Benzo(a)pyrene monooxygenase, Organic compounds.

Benzo(a)pyrene monooxygenase (BaPMO) activity in non-migratory fish from a given river segment is highly correlated to the recent pollution history of that part of the river. The enzyme activity level can serve as a relevant measure for the harmful pollutant potential in aquatic ecosystems. Caged experimental fish exposed for about 10 days in river segments show BaPMO activity changes with the same predictive validity as that of the natural population. The dependence of the BaPMO activities from different river segments on the degree of pollution is demonstrated. Measurement of liver BaPMO activities in natural fish populations could be used for detecting the presence, and estimating the quantity of xenobiotics in water. (Baker-IVI)
W84-03991

MUTAGENIC AND CLASTOGENIC EFFECTS OF ORGANIC EXTRACTS FROM THE ATHENIAN DRINKING WATER,
National Hellenic Research Foundation, Athens (Greece). Biological Research Center.
K. Athanasiou, and S. A. Kyrtopoulos.
The Science of the Total Environment, Vol. 27, No. 2/3, p 113-120, 1983. 1 Fig, 3 Tab, 23 Ref. Greek Agency for Scientific Research and Technology grants No. 80045 and 80018.

Descriptors: *Organic compounds, *Drinking water, *Athens, *Greece, *Mutagens, *Clastogens, Chlorination, Agriculture, Public health, Toxicity.

Organic extracts of chorinated drinking water collected from the water distribution system of Athens, Greece, were tested in parallel for their ability to cause mutations in the Salmonella His(+) reversion system and sister chromatid exchanges (SCE) and chromosomal aberrations in CHO cells. The Athens water distribution system supplies a population of more than 3 million people. Water is received into the system from the artificial lake of Marathon. This lake collects the waters of a river (Mornos) located at a distance of 200 km northwest of Athens by means of a canal, and those of the natural lake of Heliki, 100 km north of Athens, in the middle of one of the main cultivated areas of Greece. The extracts induced His(+) revertants in frequencies similar to those detected previously with drinking water extracts from other areas around the world. Organic samples from surface drinking water induced SCE and chromatid type abnormalities in CHO cell cultures, while samples collected from ground drinking water did not. It is possible that the high percentage of mutagens detected in this study results from the chlorination of constituents derived from agricultural runoff. (Baker-IVI)
W84-03993

GROWTH, FECUNDITY AND MORTALITY OF BREAM (ABRAMIS BRAMA) FROM POLLUTED AND LESS POLLUTED SURFACE WATERS IN THE NETHERLANDS,
Rijksinstituut voor Drinkwatervoorziening, Leidschendam (Netherlands).
W. Slooff, and D. de Zwart.
The Science of the Total Environment, Vol. 27, No. 2/3, p 149-162, April, 1983. 3 Fig, 7 Tab, 34 Ref.

Descriptors: *Water pollution effects, *Fish, *Bream, *Netherlands, Surface water, Lakes, Rivers, Rhine River, Meuse River, Lake Braassem, Lake IJssel.

The performance of bream from surface waters with different degrees of chemical pollution was studied in terms of growth, fecundity, and mortality. Nearly 7000 bream were examined from the river Rhine and its tributaries, the river Meuse and the Lakes Braassem and IJssel. In the polluted areas of the Rhine and its tributaries, fish showed a higher annual mortality than those from less polluted waters. They also, however, showed a higher fecundity, suggesting a compensatory response to an environmental impact. The growth in succeeding spawning years indicates a significant improvement of growth as the population density of Rhine bream has increased during the last few years. The stress of the impact has been reduced recently. The biological observations correspond with differences in chemical pollution of the surface waters which have been surveyed and with a decrease in the concentration of pollutants in Rhine water during the last decade. (Baker-IVI)
W84-03994

ORGANIC CONTAMINANTS IN THE AQUATIC ENVIRONMENT; III. PUBLIC HEALTH ASPECTS, QUALITY STANDARDS AND LEGISLATION,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
N. D. Bedding, A. E. McIntyre, and J. N. Lester.
The Science of the Total Environment, Vol. 27, No. 2/3, p 163-200, April, 1983. 13 Tab, 56 Ref. Science and Engineering Research Council Grant GR/B/18263.

Descriptors: *Organic compounds, *Water pollution effects, *Literature review, Public health, Water quality control, Standards, Legislation, Drinking water, Environmental effects.

The health aspects and possible risks from the presence of organic micropollutants in water and waste waters are discussed in this literature review. A comparison is made of the quality standards and legislation which have been promulgated by some countries and international oganizations pertaining to the control of certain organic compounds. Different standards may be applied to waters which are designated for particular uses. Quality standards for the protection of the aquatic environment are generally more stringent than those applied to drinking water. Quality standards developed by different countries and organizations display a broad similarity in most cases, but differ where various approaches have been used in determining the toxicity of and hazards presented by individual compounds. Such legislation will become more comprehensive in the future as more substances are included for recommended treatment procedures. (Baker-IVI)
W84-03995

RECREATIONAL WATER QUALITY AND HUMAN HEALTH,
Health and Welfare Canada, Ottawa (Ontario). Health Protection Branch.
A. B. Morrison.
Canadian Journal of Public Health, Vol 75, No. 1, p 13-14, January/February, 1984.

Descriptors: *Reviews, *Water quality, *Recreation, Jurisdiction, Standards, Research priorities, Canada.

A brief review of the First National Conference on Recreational Water Quality and Human Health is discussed. A coordinated effort is necessary for the accomplishment of water quality and human health needs. One mechanism to coordinate federal and provincial activities in the environmental and occupational health field is the Federal-Provincial Advisory Committee on Environmental Health. In developing guidelines for adequate recreational water quality standards it became evident that further research and data-gathering were required. Studies were necessary to determine the association between swimming and microbiological quality of water; investigations on the use of fecal streptococci or enterococci as indicator organisms in bathing beaches; improvement and standardized methods for the isolation and enumeration of viruses in recreational water; improved methods for the isolation and enumeration of pathogens in water; elucidate the extent and degree of recreational water pollution by stormwater and land runoff; obtain communication and cooperation among the agencies responsible for bathing beach water quality. (Murphy-IVI)
W84-04007

VIRUSES AND BATHING BEACH QUALITY,
Institut Armand-Frappier, Laval (Quebec). Centre de Recherche en Virologie.
P. Payment.
Canadian Journal of Public Health, Vol. 75, No. 1, p 43-48, January/February, 1984. 6 Fig, 1 Tab, 15 Ref.

Descriptors: *Viruses, *Water quality, *Bathing beach, Recreation, Enteric viruses, Epidemiology, Bacteria, Enterococcus, Poliovirus, Echoviruses, Wastewater disposal, Wastewater pollution, Surface water, Montreal, Canada.

Enteric viruses are always present in domestic sewage as they are constantly being excreted by infected individuals with or without apparent symptoms. Any recreational water contaminated by sewage will thus contain potentially pathogenic viruses. Epidemiological studies have demonstrated that even in the presence of low numbers of bacteria in bathing water there is an increased risk of contracting gastrointestinal illness. Part of this risk is likely to be due to the presence of viruses which have very low minimal infective doses: for poliovirus and echovirus 12, the 50% infective dose is only 20 to 30 viruses. Calculation of the risks involved in bathing in virus contaminated waters show that a standard of less than 25 viruses/L would bring the number of cases to less than 25/1000 bathers. The absence of viruses in one liter of water would insure that there is less than 1 case/1000 bathers. As the endemic level of gastrointestinal symptoms in the population is 25 to 50 cases/1000 persons, this increase would be undetectable. Such a standard would only be adequate if used in conjunction with the present bacteriological standards and perhaps the addition of an enterococcus standard. (Author's abstract)
W84-04011

OTITIS EXTERNA INFECTIONS RELATED TO PSEUDOMONAS AERUGINOSA LEVELS IN FIVE ONTARIO LAKES,
Toronto Univ. (Ontario). Dept. of Microbiology.
P. L. Seyfried, and R. J. Cook.
Canadian Journal of Public Health, Vol. 75, No. 1, p 83-91, January/February, 1984. 1 Fig, 7 Tab, 35 Ref.

Descriptors: *Otitis Externa, *Pseudomonas Aeruginosa, *Ontario, Lakes, Recreational, Human pathology, Bacteria, Canada.

Studies were undertaken during the summers of 1974 and 1977 to establish the relation of serotypes and phage types of Pseudomonas aeruginosa in recreational water to local cases of external otitis. It was found that there was an increased incidence of infection among swimmers who swam in areas of the lakes where counts were highest. A survey of 424 swimmers and non-swimmers showed that there is a higher occurrence of otitis externa among people under 19 years of age who swim at least five times per week and who have a history of previous ear pathology. (Author's abstract)
W84-04016

GLUCOSE MINERALIZATION ACTIVITY AND THE USE OF THE HETEROTROPHIC ACTIVITY METHOD IN AN ACIDIFIED LAKE,
Laurentian Univ., Sudbury (Ontario). Dept. of Biology.
L. G. Leduc, and G. D. Ferroni.
Water Resources, Vol. 18, No. 5, p 609-612, 1984. 4 Fig, 2 Tab, 17 Ref.

Descriptors: *Glucose, *Mineralization, *Heterotrophic activity method, Acidic water, Bacteria, Glucose mineralization, Hydrogen ion concentration, Ecological effects, Silver Lake, Sudbury, Ontario.

Before a definite conclusion could be made concerning the usefulness of the 'heterotrophic activity method' to measure the rates of decomposition processes in acidic, aquatic environments, it was necessary to study in situ glucose mineralization. Bacterial glucose mineralization samples were taken during the summer from Silver Lake. For Sampling I, linearity between turnover time (t/f) and added substrate concentration (A) did not exist at the in situ pH (3.2) or the experimental pH's (5.5 and 7.0), even though time studies showed that glucose was being mineralized at measurable rates. For Sampling II, modifications were made to the concentrations of labelled glucose and the incubation time. A highly significant linear relationship between t/f and A was demonstrated, and the turnover time and Vmax were calculated to be 472.3 h and 0.005 microg/l/h, respectively. For Sampling III, even though the environmental conditions were similar to those for the previous sampling, a statistically-significant relationship between t/f and A did not result. (Murphy-IVI)
W84-04026

MICROBIOLOGICAL EFFECTS OF WASTEWATER EFFLUENT DISCHARGE INTO COASTAL WATERS OF PUERTO RICO,
Maryland Univ., College Park. Dept. of Microbiology.
D. J. Grimes, F. L. Singleton, J. Stemmler, L. M. Palmer, and P. Brayton.
Water Resources, Vol. 18, No. 5, p 613-619, 1984. 2 Fig, 2 Tab, 24 Ref. NOAA grant NA79AA-D00062, and Office of Naval Research grant N00014-81-K-0638.

Descriptors: *Wastewater discharge, *Ecological effects, *Microbiological studies, *Coastal waters, *Puerto Rico, Fecal coliforms, Coliforms, Bacteria, Chemical wastewater, Domestic wastewater, Streptococcus, Pathogens.

Microbiological effects of non-disinfected, combined chemical and domestic wastewater effluent discharge into coastal waters north of Barceloneta, Puerto Rico were investigated by membrane filter enumeration of fecal indicator bacteria and by enrichment isolation of specific pathogens. A wastewater plume was detected and delineated around the sewage outfall, located 800 m offshore and 30 m below the ocean surface. Fecal coliform and fecal streptococcus counts within the plume were significantly (F test) larger than comparable counts outside the plume. The shape and location of the plume was compatible with current patterns and prevailing winds and extended as far as 3.7 km west of the outfall, at which point the fecal coliform count was 146/100 ml. The average non-plume fecal coliform concentration was < or = 6.7/100 ml. Specific pathogens isolated included Salmonella and Vibrio spp, including V. cholerae non-01 serovar isolated from a nearby river also impacted by the sewage plant. (Author's abstract)
W84-04027

LEAD AND CADMIUM CONCENTRATIONS IN THE HAIR OF FISHERMEN FROM THE SUBAE RIVER BASIN, BRAZIL,
Universidade Federal da Bahia, Salvador (Brazil).
F. Carvalho, T. M. Tavares, S. P. Souza, and P. S. Linhares.
Environmental Research, Vol. 33, No. 2, p 300-306, April, 1984. 1 Fig, 6 Tab, 20 Ref.

Descriptors: *Lead, *Cadmium, *Hair, *Fisherman, Subae River, Industrial wastes, Lead smelter, Metals, Environmental effects, Fate of pollutants, Brazil.

Previous studies have shown heavy pollution by lead and cadmium in the Subae River basin, State of Bahia, Brazil, caused by a lead smelter. Concentrations of these metals were determined in scalp hair of fishermen from three riverside towns and from a reference town. Increased levels for both metals were associated with increasing proximity to the smelter. Mean concentrations of lead and cadmium were higher among fishermen with straight hair than among those with curly hair. The effects of hair washing, hair type, and color and age on metal concentrations in fishermen's hair were studied. (Author's abstract)
W84-04030

CYTOGENETIC EFFECTS OF CADMIUM ACCUMULATION ON WATER HYACINTH (EICHHORNIA CRASSIPES),
Universidad Nacional Autonoma de Mexico, Mexico City. Dept. de Quimica de la Atmosfera y Estudios del Agua.
I. Rosas, M. E. Carbajal, S. Gomez-Arroyo, R. Belmont, and R. Villalobos-Pietrini.
Environmental Research, Vol. 33, No. 2, p 386-395, April, 1984. 1 Fig, 5 Tab, 63 Ref.

Descriptors: *Cytogenetic effects, *Cadmium, *Water hyacinth, Accumulation, Bioindicators, Water pollution effects.

Cadmium was bioassayed to observe cytogenetic effects in the water hyacinth (Eichhornia crassipes). Plants were exposed for 96 hr to freshwater containing 0.01, 0.05, 0.10, 1, 5, and 10 mg/liter of cadmium. Metal concentrations in tissues were determined by atomic absorption spectrophotometry. The highest level was found in roots, thus root-tip cells were used for cytogenetic studies; after 24 hr of exposure, micronuclei, c-mitotic effects, and pycnosis were detected and after 48 hr polyploidy was observed. A linear relationship between frequencies of micronuclei and cadmium concentrations was found; at 1,5, and 10 mg/liter micronuclei numbers were always the lowest. The inhibition of cell proliferation, shown by the low mitotic index, was proportional to the concentration and time of exposure. It may be concluded that water hyacinth is a good sensor, due to its fast rate of metal accumulation, which allows an easy way to determine the presence of potential mutagenic compounds in water. (Murphy-IVI)
W84-04031

DILEMMA OF AN ACIDIC SKY,
Kellogg Corp., Littleton, CO.
T. Jenkins.
American Water Works Association Journal, Vol. 76, No. 3, p 42-49, March, 1984. 3 Fig, 61 Ref.

Descriptors: *Water pollution effects, *Acid rain, Sulfates, Nitrates, Reviews, Water pollution sources, Acidity, Forests, Lakes, Rivers, Legislation, Clean Air Act.

The damaging effects of acid precipitation in North America and Europe are reviewed, followed by a commentary on the controversial political and economic issues associated with forestalling deterioration of the environment. Acid rain refers to the deposition of atmospheric pollutants on soils, vegetation, surface waters, and man-made objects ultimately causing damage because of the pollutants' acidity. Apparent sources of acid atmosphere are primarily human activities. The effects on lakes, rivers, and forests are described. It has been estimated that acid rain causes as much as $5 billion annually in environmental damage, mostly in the northeastern United States and Canada; reducing emissions will cost from $3 to $7

billion annually. Proposed amendments to the Clean Air Act are listed. A comprehensive bibliography is included. (Baker-IVI)
W84-04083

EFFECTS OF ACID PRECIPITATION RUNOFF ON SOURCE WATER QUALITY,
Institute for Research on Land and Water Resources, University Park, PA.
R. T. Leibfried, W. E. Sharpe, and D. R. DeWalle.
American Water Works Association Journal, Vol. 76, No. 3, p 50-53, March, 1984. 2 Fig, 17 Ref.

Descriptors: *Water pollution effects, *Acid rain, *Runoff, *Water quality, Jennerstown, Boalsburg, Pennsylvania, Drinking water, Aluminum, Ryznar Stability Index.

During episodes of acid runoff in February of 1981 and March of 1983, the quality of water in two small streams that provide supplies to the water systems of Jennerstown and Boalsburg, Pennsylvania was monitored. A small impoundment on Card Machine Run provides part of the water for the village of Jennerstown, and Galbraith Gap Run supplies water to a small impoundment that is the main source of water for the town of Boalsburg. Changes in pH, in the concentration of aluminum, and in the Ryznar Stability Index were determined. The magnitude and potential importance of these changes are discussed. Differences in water quality between these two watersheds may have been due to differences in soils, geology, and long-term loadings of acid precipitation on these areas. It is unclear as yet whether the observed changes in source water quality will produce similar changes in the quality of tap water provided to customers in the systems studied. (Baker-IVI)
W84-04084

CURRENT RESEARCH ON THE EFFECTS OF ACID DEPOSITION,
Minnesota Univ., St. Paul. Dept. of Forest Resources.
J. A. Perry.
American Water Works Association Journal, Vol. 76, No. 3, p 54-59, March, 1984. 2 Fig, 1 Tab, 22 Ref.

Descriptors: *Water pollution effects, *Acid rain, Emissions, Corrosion, Heavy metals, Metals, Forests, Catchment areas, Water distribution.

Preliminary research aimed at quantifying relationships between emission and acid deposition and on-the-ground effects indicates that small water supplies fed by surface waters or shallow wells and cistern supplies may be adversely affected by acid deposition. Research on acid deposition must address issues such as atmospheric chemistry, distance of transport, and deposition monitoring, in addition to the study of a wide range of other effects. Any decision about methods of controlling acid deposition will ultimately be made on the basis of the effects, and those effects may be real or perceived. Research includes such diverse arenas as a forest canopy's interaction with acidic mists, the geochemistry of stream environments, and the effects on building materials and on the preservation of artifacts, such as the Statue of Liberty, that are located outdoors. Public health aspects, including potential effects on domestic water supplies, are being actively studied. Acid deposition may affect water supplies in three ways: delivery of contaminated water to the catchment, mobilization of contaminants within the catchment, and mobilization of contaminants by corrosion of distribution systems. (Baker-IVI)
W84-04085

ACID PRECIPITATION AND DRINKING WATER SUPPLIES,
Pirnie (Malcolm), Inc., White Plains, NY.
J. S. Reed, and J. C. Henningson.
American Water Works Association Journal, Vol. 6, No. 3, p 60-65, March, 1984. 3 Fig, 2 Tab, 26 Ref.

Descriptors: *Acid rain, *Drinking water, *Water pollution effects, Heavy metals, Lead, Lakes, Phytoplankton, Algae growth, Corrosion, Emissions, Fish.

Three areas of concern about the effect of acid precipitation on drinking water supplies were evaluated: the increased levels of heavy metals in raw water, biological imbalances in water supplies, and increased corrosivity of delivered water. Concentrations of heavy metals are below maximum contaminant levels with the exception of lead in a very small number of unbuffered lakes. Trends of levels of metals as a result of continued acid loading are not able to be evaluated with the present data. Phytoplankton populations are frequently less diverse in acidified lakes. Corrosive water is a widespread problem in the United States affecting tap water aesthetics, pipe and plumbing longevity, and, potentially, the health and welfare of the consumer. The distribution of corrosive waters in the state of New York has not been documented. Shallow well water in the Adirondack Mountains is highly corrosive, suggesting the influence of acid precipitation. Strategies to limit acid precursors in the atmosphere are now under intense debate in Congress. Liming, with a treatment life of three years or more, has been demonstrated as an economical and reasonably effective method for restoring fish life in acidified Adirondack lakes. Corrosion control is practiced by only a small percentage of public water systems that have corrosive waters, despite the high cost of corrosion damage and the potential adverse health effects. Effective corrosion control measures include pH adjustment and the addition of corrosion inhibitors at the treatment plant, revisions of plumbing codes, and increased public awareness. (Baker-IVI)
W84-04086

DISTRIBUTION OF HEMICELLULOSE-DECOMPOSING BACTERIA AND ENVIRONMENTAL CONDITIONS IN THE BOTTOM SEDIMENTS IN HIRO BAY,
Shimonoseki Univ. of Fisheries (Japan). Lab. of Microbiology.
M. Murakami, and H. Fujisawa.
Bulletin of the Japanese Society of Scientific Fisheries, Vol. 49, No. 11, p 1707-1715, November, 1983. 1 Fig, 7 Tab, 9 Ref.

Descriptors: *Pulp wastes, *Water pollution effects, *Bacteria, *Hemicellulose decomposing bacteria, *Hiro Bay, *Japan, Heterotrophic bacteria, Aerobic bacteria, Anaerobic bacteria, Agar, Xylan, Glucomannan, Sulfate reducing bacteria.

In the bottom sediments of Hiro Bay (Japan), which is polluted with kraft pulp mill effluent, the distribution of heterotrophic bacteria and hemicellulose-decomposing bacteria, and the environmental conditions were investigated five times from 1979 to 1981. The results on aerobic bacteria were as follows: the number of heterotrophic bacteria, glucomannan-decomposing bacteria, xylan-decomposing bacteria and agar-decomposing bacteria per g of wet sediments were 1000 to 10,000,000, 1000 to 10,000,000, 1000 to 100,000 and 100 to 10,000, respectively. The results on anaerobic bacteria were as follows: the number of heterotrophic bacteria, glucomannan-decomposing bacteria, xylan-decomposing bacteria and sulfate-reducing bacteria per g of wet sediments, were 10,000 to 1,000,000, 100 to 10,000,000, 1000 to 1,000,000 and 1000 to 10,000,000, respectively. The number of aerobic xylan-decomposing bacteria and sulfate-reducing bacteria in Hiro Bay were higher than those in the unpolluted control area (Yoshimi Bay), and the ratio of the number of hemicellulose-decomposing bacteria to that of heterotrophic bacteria in Hiro Bay was also high. (Author's abstract)
W84-04121

ROLE OF EPIDEMIOLOGIC STUDIES IN DERIVING DRINKING WATER STANDARDS FOR METALS,
Massachusetts Univ., Amherst. Dept. of Public Health.
E.J. Calabrese.
Environmental Health Perspectives, Vol. 52, p 99-106, October, 1983. 2 Fig, 1 Tab, 31 Ref. EPA Grant R-805612-02.

Descriptors: *Public health, *Drinking water, *Heavy metals, Arsenic, Sodium, Epidemiology, Reviews, Standards, Metals.

Epidemiological investigations are shown to have contributed in a significant way to our understanding of the potential adverse health effects of drinking water containing elevated levels of several metals. The major restraint in conducting epidemiological research in this area of study has been the mistaken view that drinking water usually contributes only a small percentage of the total daily exposure to any substance. Particular attention in this review is given to arsenic and sodium effects. The sodium tests indicate a sensitivity to blood pressure reduction for women but not for men when small amounts of sodium are removed from the drinking water. Three recent studies in the United States did not find a positive relationship between excess levels of arsenic in drinking water and adverse health effects. (Baker-IVI)
W84-04123

EFFECT OF SODIUM ALKYLBENZENE SULFONATES ON BACTERIOPLANKTON OF THE KIEV RESERVOIR,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
N. A. Potapova, and N. P. Galagan.
Hydrobiological Journal, Vol. 19, No. 1, p 45-48, 1983. 2 Fig, 8 Ref.

Descriptors: *Bacteria, *Plankton, *Reservoirs, Sulfonates, Water pollution effects, Sodium alkylbenzene sulfonates, Kiev, Kiev Reservoir, Bacterioplankton.

The response of bacterioplankton to alkylbenzene sulfonates (ABS) was determined at different initial concentrations of the substrate. While the response depended on the concentration of substrate used, in all experiments the indicators which were monitored showed a considerable deviation from the norm. The indices indicated that the bacterioplankton was more sensitive to a change in the initial concentration of from 2 to 20 mg ABS/liter than to a change from 20 to 100 mg/liter. (Baker-IVI)
W84-04133

BENTHIC FAUNA OF SOME RIVER SYSTEMS IN NAGASAKI DISTRICT; (8) BENTHIC COMMUNITY IN THE RIVER SASU AFTER CONSTRUCTION TO PREVENT MINE-EFFLUENT,
Nagasaki Prefecture Inst. of Health Science and Envirnomental Science (Japan).
S. Ishizaki.
Japanese Journal of Limnology, Vol. 44, No. 4, p 263-268, October, 1983. 2 Fig, 4 Tab.

Descriptors: *Benthic fauna, *River Sasu, *Japan, *Water pollution control, *Mine wastes, Water pollution effects, Heavy metals, Effluents.

The benthic community of the River Sasu was investigated in July 1981 to evaluate the influence of the construction to prevent mine-effluent. The communities in the lower reaches, where the effect of the mine-effluent was recognized in the previous surveys, showed a slight increase in the number of species and change of the dominant species. The heavy metal contents in the water of these areas had decreased in comparison with those of the previous surveys. Change in composition of the benthic community seems to be related to purification of the water quality by construction to prevent mine-effluent. There are some differences in distribution of species such as Gammarus nipponensis, Nemoura asakawae, and Semisulcospira bensoni along the water current, between the River Sasu and Se as a control river. This suggests that there is a decreased but still evident discharge from the abandoned mine in the River Sasu or that there are some discrepancies between the geographical features of both rivers. (Author's abstract)
W84-04164

STUDIES ON A FRESHWATER RED TIDE IN LAKE BIWA - III. PATTERNS OF HORIZON-

TAL DISTRIBUTION OF UROGLENA AMERICANA,
Kyoto Univ. (Japan). Div. of Tropical Agriculture.
Y. Yoshida, K. Kawaguchi, and H. Kadota.
Japanese Journal of Limnology, Vol. 44, No. 4, p 293-297, October, 1983. 7 Fig.

Descriptors: *Red tide, *Lake Biwa, *Uroglena, Plankton, Eutrophication, Chlorophyll a, Water temperature, Water circulation.

In order to clarify the patterns of horizontal distribution of Uroglena americana, investigations were conducted in the water area where the plankton accumulated in the northern basin of Lake Biwa in 1979. Small wings and a tail plane were set on an in situ fluorometer (Variosence II) with a thermistor and the instrument was towed by a ship with the speed of 4 knots at the depth 1 or 1.5 m. The following remarkable variations of patterns were found in the horizontal distribution of chlorophyll a and water temperature: chlorophyll a concentration changes in reverse proportion to water temperature; chlorophyll a concentration changes parallel with water temperature; chlorophyll a concentration changes independently with water temperature. As the cause why these various patterns were found, it was suggested that the types of vertical distributions, of both U. americana and water temperature, the buoyancy of the plankton, the convergence and sinking of surface water, and the convergence and upwelling of surface water, and so on, affected greatly the accumulation of the plankton and the formation of horizontal distribution patterns. (Author's abstract)
W84-04166

NEW GENERAL ESTIMATION OF RIVER POLLUTION USING NEW DIATOM COMMUNITY INDEX (NDCI) AS BIOLOGICAL INDICATORS BASED ON SPECIFIC COMPOSITION OF EPILITHIC DIATOMS COMMUNITIES. APPLIED TO ASANO-GAWA AND SAI-GAWA RIVERS IN ISHIKAWA PREFECTURE,
Meiho High School, Kanazawa City (Japan).
M. Sumita, and T. Watanabe.
Japanese Journal of Limnology, Vol. 44, No. 4, p 329-340, October, 1983. 6 Fig, 7 Tab, 15 Ref.

Descriptors: *Rivers, *Diatoms, Japan, Water pollution effects, Sewage, Estimating, Pollution indicators.

The Asano-gawa and Sai-gawa rivers run through Kanazawa City. Since 1960 river pollution has become much worse in the middle and lower courses of these two rivers, the leading cause of which seems to be the very large inflow of domestic sewage caused by the development of the city. River surveys taken at 20 locations allowed the identification of 19 genera and 62 taxa in the River Asano-gawa and 16 genera and 55 taxa in the River Sai-gawa. The number of taxa belonging to two genera, Navicula and Nitzschia, was greater than any number of taxa belonging to the other genera. The development of a numerical index to assess the river pollution by using the diatom community index is discussed. (Baker-IVI)
W84-04170

5D. Waste Treatment Processes

RECENT ADVANCES IN TITANIUM DIOXIDE RECOVERY, FILLER RETENTION AND WHITE WATER TREATMENT,
Lenox Inst. for Research, Inc., MA.
M. Krofta, L. K. Wang, B. C. Wu, and C. C. J. Bien.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-219543. Technical Report No. LIR/06-83/1, June, 1983. 39 p, 1 Tab, 52 Ref, 3 Append. Project No. L8203002, Contract/Grant No. R81PO1-MEAD.

Descriptors: *Pulp, Paper, *Titanium dioxide recovery, *Fillers, *Filler retention, *White water, Treatment, Water reuse, Secondary fiber, Saveall process, Flotation, *Literature review, Wastewater treatment, Byproduct recovery.

Recent developments by research scientists around the world are reviewed and introduced. Topics covered include: the characteristics and application of titanium dioxide and various potential fillers; the definition of filler retention; techniques and chemicals for enhancing filler retention; and various new processes for white water treatment and resources recovery.
W84-03672

ALGAE SEPARATION BY DISSOLVED AIR FLOTATION,
Lenox Inst. for Research, Inc., MA.
M. Krofta, L. K. Wang, R. L. Spencer, and J. Weber.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-219550. Technical Report No. LIR/5-83/6, presented at the Water Quality and the Public Health Conference, Worcester Polytechnic Institute, Worcester, MA, May 24-25, 1983. 19 p, 2 Fig, 6 Tab, 6 Ref. Project No. L8203002.

Descriptors: *Algae, *Flotation, Dissolved air flotation, *Filtration, Water quality, Wastewater treatment, Water treatment, *Separation techniques, *Algae separation.

Algae blooms generally cause a problem for treatment of both potable water supplies and wastewater. Whereas algae may be undesirable in water and wastewater treatment, algae is also being produced in some places for its nutrient value. The objective of this research is to develop a high-rate algae separation system. It has been demonstrated that the dissolved air flotation and filtration system can efficiently separate algae and other pollutants from a surface water body and produce water which meets or exceeds the U.S. Drinking Water Standards. Research data generated from both the laboratory testing, and field testing of a pilot flotation-filtration plant are presented.
W84-03673

PASTEURIZATION OF NATURALLY CONTAMINATED WATER WITH SOLAR ENERGY,
California State Univ., Sacramento. Dept. of Biological Sciences.
D. A. Ciochetti, and R. H. Metcalf.
Applied and Environmental Microbiology, Vol. 47, No. 2, p 223-228, February, 1984. 2 Fig, 2 Tab, 14 Ref.

Descriptors: *Decontamination, *Solar energy, Pasteurization, Bacteria, Solar box cooker, River water, Water quality control.

In many parts of the world, people do not have access to a safe water supply, and many diseases are transmitted by consumption of this contaminated water. A solar box cooker (SBC) was constructed with a cooking area deep enough to hold several 3.7-liter jugs of water, and this was used to investigate the potential of using solar energy to pasteurize naturally contaminated water. When river water was heated either in the SBC or on a hot plate, coliform bacteria were inactivated at temperatures of 60 C or greater. Heating water in an SBC to at least 65 C ensures that the water will be above the milk pasteurization temperature of 62.8 C for at least an hour, which appears sufficient to pasteurize contaminated water. On clear or partly cloudy days, with the SBC facing magnetic south in Sacramento, bottom water temperatures of at least 65 C could be obtained in 11.1 liters of water during the 6 weeks on either side of the summer solstice, in 7.4 liters of water from mid-March through mid-September, and in 3.7 liters of water an additional 2 to 3 weeks at the beginning and end of the solar season. Periodic repositioning of the SBC towards the sun, adjusting the back reflective lid, and preheating water in a simple reflective device increased final water temperatures. Simultaneous cooking and heating water to pasteurizing temperatures was possible. Additional uses of the SBC to pasteurize soil and to decontaminate hospital materials before disposal in remote areas are suggested. (Murphy-IVI)
W84-03701

ENTERIC VIRUS AND INDICATOR BACTERIA LEVELS IN A WATER TREATMENT SYSTEM MODIFIED TO REDUCE TRIHALOMETHANE PRODUCTION,
Health Effects Research Lab., Cincinnati, OH.
R. E. Stetler, R. L. Ward, and S. C. Waltrip.
Applied and Environmental Microbiology, Vol. 47, No. 2, p 319-324, February, 1984. 1 Fig, 6 Tab, 22 Ref.

Descriptors: *Enterovirus, *Bacteria, *Water treatment, *Trihalomethane, Water treatment facilities, Chlorination, Alternative planning, Water quality control, Bacterial analysis.

Trihalomethanes formed during the chlorine disinfection step of water treatment are considered to be potential carcinogens. A drinking-water treatment plant with high concentrations of trihalomethanes in its finished water and large numbers of viruses in its source water was located. This plant was used to study the effect of an alteration in the point of chlorination from the first to last step of water treatment on the biological and chemical qualities of its finished water. This alteration caused some reduction in trihalomethane production, but trihalomethane concentrations still exceeded the prescribed limit of 100 microg/liter. No viruses or bacterial indicators were ever isolated from the finished water of the modified plant. Total virus removal by the treatment steps before chlorination (coagulation, sedimentation, and sand filtration) averaged ca. 90%, whereas removal of bacterial indicators by these processes averaged between 88 and 98%. Recoveries of viruses and bacterial indicators in the source water were generally negatively correlated. (Murphy-IVI)
W84-03702

PENETRATION OF DIFFERENT HUMAN PATHOGENIC VIRUSES INTO SAND COLUMNS PERCOLATED WITH DISTILLED WATER, GROUNDWATER, OR WASTEWATER,
Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene.
For primary bibliographic entry see Field 5B.
W84-03704

USE OF A MIXED ALGAL CULTURE TO CHARACTERIZE INDUSTRIAL WASTEWATERS,
Uppsala Univ. (Sweden). Inst. of Physiological Botany.
For primary bibliographic entry see Field 5A.
W84-03705

ENVIRONMENTAL ASPECTS OF THE USE OF NTA AS A DETERGENT BUILDER,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5C.
W84-03730

MATERIAL BALANCES OF ORGANICS AND NUTRIENTS IN AN OXIDATION POND,
Kyoto Univ. (Japan). Dept. of Sanitary Engineering.
I. Somiya, and S. Fujii.
Water Research, Vol. 18, No. 3, p 325-333, 1984. 12 Fig, 5 Tab, 21 Ref.

Descriptors: *Oxidation ponds, *Nutrients, *Wastewater treatment, Carbon, Nitrogen, Phosphorus, Tertiary wastewater treatment, Algae, Sedimentation, Regeneration, Assimilation, Sediments, Oxidation.

The apparent removal efficiency of nutrients in a tertiary oxidation pond was 45% in total nitrogen, and 43% in total phosphorus during oxidation pond experiments with 16 days detention time. While the behaviors of these nutrients in an oxidation pond are governed by various transformation processes, the solidification of the soluble inorganic nutrients is predominantly observed. The assimilation rate ranges from 1.06 to 2.61 g C/sq m/day. In the nitrogen balance, denitrification is very im-

portant and produces 66% of the nitrogen removal. In the phosphorus balance, chemical coagulation is a characteristic reaction of phosphorus. The material balance analysis shows clearly that the main reactions in the transformation processes of carbon and nutrients are the assimilation to algae, sedimentation of suspended substance, and decomposition of sediments. The regeneration rates of nutrients from sediments were so active that the removal of nutrients by algal solidification was not effective. (Baker-IVI)
W84-03734

INHIBITORY EFFECT OF OXYGEN ON DENITRATIFICATION AND DENITRITIFICATION IN SLUDGE FROM AN OXIDATION DITCH,
Kyushu Univ., Fukuoka (Japan). Dept. of Chemical Engineering.
M. Nakajima, T. Hayamizu, and H. Nishimura.
Water Research, Vol. 18, No. 3, p 339-343, 1984. 6 Fig, 16 Ref.

Descriptors: *Denitritification, *Oxidation, *Sludge, *Denitratification, Wastewater treatment, Acetylene inhibition method, Oxidation ditch, Aerobic conditions, Anaerobic conditions, Oxygen.

The effect of oxygen concentration on the rates of denitratification and denitritification was investigated using the acetylene inhibition method. The study was conducted during the 1 hr incubation period of return sludge in an oxidation ditch after preculture under anaerobic conditions. As the oxygen concentration increased, the denitratification rate decreased. When the oxygen concentration was above 30 micro M, the reaction was completely suppressed. Denitritification, however, occurred even under aerobic conditions. In the nitrite range of 70-7000 micro M at temperatures of 13 degrees C, the denitritification rate under aerobic conditions was 5-20 micromol/(g-VSS)/hr which was 10-60% that occurring under anaerobic conditions. The inhibition of denitritification by oxygen seemed to conform to a simple competitive inhibition mechanism. (Baker-IVI)
W84-03736

EFFECTS OF PHENOL AND SOME ALKYL PHENOLICS ON BATCH ANAEROBIC METHANOGENESIS,
Alberta Univ., Edmonton. Dept. of Chemistry.
P. M. Fedorak, and S. E. Hrudey.
Water Research, Vol. 18, No. 3, p 361-367, 1984. 5 Fig, 4 Tab, 19 Ref.

Descriptors: *Wastewater treatment, *Phenols, *Anaerobic digestion, Cresol, Methane, Biological treatment, Biological wastewater treatment.

Screening experiments with four dimethyphenols, the three cresols and phenol confirmed that only p-cresol and phenol are anaerobically degraded with methane generation. In general, low concentrations of either degradable or non-degradable phenolic substrates were not inhibitory to methanogenesis of other organics in the sludge. Further experiments with varying concentrations of phenol and p-cresol with and without supplemented volatile organic acids showed that the phenol- and p-cresol-degrading acid-forming bacteria are most susceptible to inhibition by the phenolic substrate. By comparison, the non-phenol-degrading acid-formers and methanogens are less susceptible. Accumulation times for phenol and p-cresol methanogenesis were concentration dependent with higher phenolic concentrations requiring longer acclimation times. (Baker-IVI)
W84-03739

USE OF ARTIFICIAL WETLANDS TO REMOVE NITROGEN FROM WASTEWATER,
Ecological Research Associates, Davis, CA.
R. M. Gersberg, B. V. Elkins, and C. R. Goldman.
Journal of the Water Pollution Control Federation, Vol. 56, No. 2, p 152-156, February, 1984. 5 Fig, 1 Tab, 16 Ref. EPA grant CR 807299-01, California Dept. of Water Resources grant B-53459.

Descriptors: *Nitrogen removal, *Wastewater renovation, *Wetlands, Water reuse, Denitrification, Water supply development, Reclaimed water, Wastewater treatment.

Artificial wetlands, when supplemented with methanol to increase the carbon supply and stimulate denitrification, showed very high nitrogen removal efficiencies, 97% of total inorganic nitrogen (TIN) and 94% of total nitrogen (TN) at application rates of 20 to 25 cm/d. Plant biomass, mulched and applied to the surface of the wetlands, was a low-cost alternative to methanol. At a wastewater application rate of 8.4 to 12.5 cm/d, the mean nitrogen removal efficiencies for mulch-amended beds were 95% for TIN and 89% for TN. When the application rate was increased to 17 to 20 cm/d, the mean removal efficiencies decreased to 70% for TIN and 65% for TN. At a wastewater application rate of 8.4 cm/d, endogenous wetland productivity could supply 0.06 kg/cu m carbon, or 67% of the carbon loading value of 0.09 kg/ cu m at which there was an 89% removal of TN. When primary effluent was blended into the secondary wastewater stream at a ratio of 4 cm/d:15 cm/d, the mean nitrogen removal efficiency was 62% for TIN. At the ratio of 6 cm/d:12 cm/d, the mean removal efficiencies were 79% for TIN and 77% for TN. The utility of the artificial wetlands for integrated biological treatment, to perform secondary treatment and nitrogen removal is thus demonstrated. (Baker-IVI)
W84-03794

ANAEROBIC DIGESTION,
Queensland Univ., Brisbane (Australia). Dept. of Chemical Engineering.
W. Forday, and P. F. Greenfield.
Effluent and Water Treatment Journal, Vol. 23, No. 10, October, 1983. 1 Fig, 4 Tab, 58 Ref.

Descriptors: *Anaerobic digestion, *Wastewater treatment, Bacteria, Temperature effects, Metals, Heavy metals, Design criteria.

The principle aims of biological waste treatment are to convert soluble and colloidal wastes into either solid or gaseous materials, thereby making separation easier, and to reduce the volume of solids material which must be handled by partial conversion to the gas phase. In anaerobic digestion, primary, and secondary sludges or high strength wastes are converted to methane, carbon dioxide and a mush smaller amount of solid biomass. The microbiology of anaerobic digestion, environmental effects, and elementary process design concepts are discussed and aerobic and anaerobic systems are compared. Fundamental microbiological and bench scale studies are continually providing a better base on which to design and operate digesters. Novel technological developments have helped to overcome the inherently slow specific rates of organic removal. At the same time, there is growing awareness that certain industrial wastes are not best treated by conventional aerobic processes. Hence, anaerobic digestion now competes with the more expensive specialized aerobic processes. It would appear that there are a number of industrial wastes for which anaerobic treatment is a cost effective, technically sound option. (Baker-IVI)
W84-03881

TRICKLING FILTER ACTIVATED SLUDGE PLANT - PERFORMANCE IN IBADAN,
Ministry of Environment, Ibadan (Nigeria).
C. M. A. Ademoroti.
Effluent and Water Treatment Journal, Vol. 23, No. 10, p 415-419, October, 1983. 2 Fig, 5 Tab, 6 Ref.

Descriptors: *Trickling filters, *Activated sludge process, Wastewater treatment, Wastewater facilities, Suspended solids, Biological oxygen demand, Water quality, Ibadan, Nigeria.

Studies were conducted to determine the qualities of the effluents obtained from a conventional treatment plant in Ibadan. The plant consists of a trickling filter coupled with surface aerated activated sludge unit. It treats wastewater of medium strength coming from a university college hospital community. The average amount of wastewater produced daily by the community is 2.27 x 100 cu m. The plant has been found to reduce the suspended solids, BOD, ammonia-N, phosphate and total coliforms by 85.5%, 92.7%, 64.0%, 6.5% and 92.7%, respectively. However, the nitrate amount was found to increase progressively in the treatment units of the plant. (Author's abstract)
W84-03882

PAPER MILL EFFLUENT TREATMENT,
R. Bragg.
Effluent and Water Treatment Journal, Vol. 23, No. 10, p 435, 1984. 1 Fig.

Descriptors: *Wastewater treatment, *Pulp and paper industry, Pulp wastes, Sludge disposal, Pumps.

Numerous types or grades of effluent are produced from the vast amounts of water used in the paper manufacturing industry. A manufacturer producing a good quality coated paper using clay, filler, and satin white produces an effluent of 350/1100 ppm COD, 500/2400 ppm SS, with a temperature of 22/30 C at a nominal flow rate of 35,000 GPH. Treatment of effluent from such a plant is discussed including the aspects of sludge disposal and pumping requirements. Treatment includes flocculation, clarification, sludge settling, and filtration. The sludge is thickened and dewatered. The treatment allows the recovered water to be reused in the plant or to be acceptable for discharge to the sewer or water course. (Baker-IVI)
W84-03883

BIOLOGICAL NUTRIENT REMOVAL IN THE PHOREDOX PROCESS,
National Inst. for Water Research, Pretoria (South Africa).
A. Gerber.
Effluent and Water Treatment Journal, Vol. 23, No. 11, p 460-467, November, 1983. 5 Fig, 2 Tab, 11 Ref.

Descriptors: *Wastewater treatment, *Phosphorous removal, *Activated sludge process, Suspended solids, Nutrients, Municipal wastes, South Africa, Design criteria, Phoredox process.

The phoredox process is a treatment sequence specifically designed to remove both nitrogen and phosphate from wastewater. In its most general form this system consists of five stages; the Bardenpho sequence with an additional stage, the anaerobic zone, placed at the head of the process. The phoredox process is generally capable of producing a high quality effluent without the use of chemicals, subject to the presence of sufficient biodegradable organics in the feed, and the provision of adequate anaerobic and primary anoxic retention time. A 100 cu m/d pilot plant was operated continuously for about two years to determine its nutrient removal capability under conditions of rigid plant configuation and operating rules, and to gain an understanding of problems likely to be encountered in practical applications. The wastewater comprised approximately 80% domestic sewage and 20% industrial effluents. Operation of the phoredox pilot plant proved that COD removal and nitrification could be maintained at high levels of efficiency. At an overall average influent COD value of 330 mg/l, phosphate was reduced from 7.2 to an average of 0.8 mg/l in spite of a relatively unfavorable COD/TKN ratio of 9:2 and effluent nitrate concentration of 6.4 mg/l. (Baker-IVI)
W84-03885

REMOVAL OF HYDROCARBONS FROM NILE WATER,
National Research Centre, Cairo (Egypt). Water Pollution Control Lab.
A. S. Moursy, and H. I. Abdel-Shafy.
Environment International, Vol. 9, No. 3, p 165-171, 1983. 8 Fig, 7 Tab, 27 Ref.

Descriptors: *Water treatment, *Chlorination, *Coagulation, *Filtration, *Nile River, *Egypt,

*Hydrocarbons, Organic compounds, Rivers, Adsorption, Turbidity, Activated carbon.

The Nile River is the main water supply in Egypt. To determine the efficiency of the existing water treatment facilities in removing hydrocarbons, Nile water was subjected to the same treatment processes used in the local water works. The effectiveness of physicochemical processes involving chlorination, chemical coagulation and sand filtration were investigated. The effect of variable filtration media was also examined. The use of an activated carbon column was considered and the effect of different retention times was evaluated. Chemical coagulation was not an efficient process for hydrocarbon removal. Filtration using either sand or a mixture of anthracite/sand media significantly increased the efficiency of hydrocarbon removal. Increasing the anthracite depth with respect to the total effective depth increased the efficiency of removal of both hydrocarbons and turbidity. Extending the study to include carbon adsorption at different retention times showed that the removal levels of hydrocarbons and turbidity increased by increasing the contact time. The use of activated carbon filter is a promising technique for hydrocarbon removal. (Baker-IVI)
W84-03890

WATERHYACINTHS FOR WATER QUALITY IMPROVEMENT AND BIOMASS PRODUCTION,
Agricultural Research and Education Center, Sanford, FL.
K. R. Reddy, and D. L. Sutton.
Journal of Environmental Quality, Vol. 13, No. 1, p 1-8, January-March, 1984. 63 Ref.

Descriptors: *Waterhyacinths, *Water quality, *Biomass, Wastewater treatment, Agricultural wastes, Eutrophic lakes, Aquatic plants, Nitrogen removal, Phosphorus removal, Anaerobic digestion, Water pollution control, Biological treatment, Nutrient removal, Evapotranspiration.

Waterhyacinth, Eichhornia crassipes (Mart.) Solms, is one of the most prominant aquatic weed plant found throughout the tropical and subtropical areas of the world. Researchers have recently recognized that with proper management, waterhyacinth can be effectively used to reduce the pollutant levels of water bodies and potentially use the resulting biomasss for production of gaseous fuels, feed, and fiber. Warm climates in tropical and subtropical areas are conducive for establishing wastewater treatment systems and biomass production farms with waterhyacinth. Sources of nutrients available to culture waterhyacinths include sewage effluent, agricultural drainage water, runoff from animal waste operations, methane digestor effluent, and water from eutrophic lakes and rivers. Growth rates of waterhyacinths were found to be influenced by the nutrient composition of the water, plant density, solar radiation, and temperature. Annual yields of waterhyacinth biomass were found to range from 47 to 106 Mg dry wt/ha/y, with approximately 50% of the biomass produced during May through August. About 35 to 50% of the total biomass was roots when plants were cultured in nutrient-poor waters (eutrophic lake water and drainage effluents), while 14 to 25% of the total biomass was roots for the plants grown in nutrient-rich waters (sewage effluent). Waterhyacinth systems were found to be more efficient in N removal (70-80% reduction) than in P removal (40-50% reduction). A pond with a surface area of 2.65 ha and 1.0 m in depth containing 15 to 30 kg wet wt of waterhyacinth per square meter (750-1500 g dry wt/sq m) and a detention period of 7 d is adequate to treat 3785 cu m/d, million gallons per day (mgd), of sewage effluent. This hypothetical system would achieve 70 to 80% N removal, 40 to 50% P removal, and would produce a biomass yield of 690 to 1060 kg dry wt/d (13-20 g dry wt/sq m/d). The biomass upon anaerobic digestion would yield 180 to 280 cu m of methane/d. This is equivalent to 549 to 843 GJ/ha of energy from waterhyacinth produced at a rate of 48 to 73 Mg dry wt/ha/y. (Murphy-IVI)
W84-03934

FIELD PERFORMANCE OF CONVENTIONAL AND ALTERNATIVE SEPTIC SYSTEMS IN WET SOILS,
North Carolina State Univ. at Raleigh. Dept. of Soil Science.
C. G. Cogger, and B. L. Carlile.
Journal of Environmental Quality, Vol. 13, No. 1, p 137-142, 1984. 3 Fig, 4 Tab, 24 Ref.

Descriptors: *Performance evaluation, *Septic tanks, *Wet soils, Soil saturation, Soil water table, Groundwater pollution, Wastewater treatment, Low-pressure pipes.

Soils with seasonally or permanently high water tables are not considered suitable for septic-tank soil-absorption systems because effluent may not be adequately treated before it enters the groundwater. A number of alternative septic systems have been developed for use in these soils. An 18-month field evaluation of 15 conventional and alternative septic systems was conducted to determine their effectiveness in soils with high water tables. The alternative designs included four low-pressure pipe (LLP) systems, two soil replacement systems, and two pressure-dosed mounds. Water tables were measured and groundwater samples collected monthly from shallow wells placed around each system. The water samples were analyzed for NO3(-)-N, NH4(+)-N, total Kjeldahl N, total P, and fecal coliform bacteria. All but one of the systems installed beneath the natural soil surface were saturated with groundwater for at least part of the year. Effluent treatment was poorest around systems that were continuously saturated with groundwater, with average levels of 7.3 mg/L NH4(+)-N, 1.0 mg/L NO3(-)-N, and 1700 fecal coliform most probable number (MPN)/L found in the groundwater in wells 1.5 m from these sytems. Systems that were only seasonally saturated generally performed better, with average levels of 2.3 mg/L NH4(+)-N, 2.0 mg/L NO3(-)-N, and 560 fecal coliform MPN/L in the groundwater. Mean P levels in the groundwater exceeded 1 mg/L around six of the systems. The highest concentrations were associated with the most heavily loaded systems. Levels of all contaminants decreased with distance from the source. The greatest amount of lateral transport occurred when continuous saturation was accompanied by a steep groundwater gradient. Improved treatment was obtained using the LLP alternative, provided site and soil conditions were acceptable. Soil replacement systems did not improve treatment, while one mound failed due to overloading and abuse. (Murphy-IVI)
W84-03946

MEANS ALLOWING TO REDUCE THE POLLUTION CAUSED BY RUNOFF WATER IN COMBINED AND SEPARATE DRAINS. A BIBLIOGRAPHIC SYNTHESIS, PART III (MOYENS D'ACTION POUR LIMITER LA POLLUTION DUE AUX EAUX DE RUISSELLEMENT EN SYSTEME SEPARATIF ET UNITAIRE. SYNTHESE BIBLIGRAPHIQUE, PARTIE III),
J. Ranchet, and Y. Ruperd.
Tribune du Cebedeau, Vol. 36, No. 472, p 117-130, 1983. 20 Fig, 3 Tab.

Descriptors: *Combined sewers, *Storm wastewater, *Water pollution control, *Wastewater treatment, Sedimentation, Clarification, Aeration, Filtration, Oil, Biological wastewater treatment.

Methods actually used or under study for use in controlling pollution from runoff water are discussed in this bibliographic synthesis. This part consists of a discussion of treatment of storm runoff from both combined sewers and separate systems. Treatment methods discussed include the following: decantation; oil and grease removal by sedimentation, clarification, aeration, and filtration; removal of suspended matter by filtration; and biological treatment by higher plants such as Phragmites, Scirpes and Typhas. (Moore-IVI)
W84-03999

MEANS ALLOWING TO REDUCE THE POLLUTION CAUSED BY RUNOFF WATER IN COMBINED AND SEPARATE DRAINS. A BIBLIOGRAPHIC SYNTHESIS, PART IV (MOYENS D'ACTION POUR LIMITER LA POLLUTION DUE AUX EAUX DE RUISSELLEMENT EN SYSTEME SEPARATIF ET UNITAIRE. SYNTHESE BIBLIOGRAPHIQUE, PART IV),
J. Ranchet, and Y. Ruperd.
Tribune du Cebedeau, Vol. 36, No. 473, p 157-175, 1983. 27 Fig, 1 Tab.

Descriptors: *Water pollution control, *Runoff, *Combined sewers, *Settling basins, Storm runoff, Wastewater treatment, Roads, Highways.

Methods actually used or under study for use in controlling pollution from runoff water are discussed in this bibliographic synthesis. This part consists of a review of the use of settling basins (or retention basins) in storm runoff treatment and the treatment of runoff from roads and highways. Retention basins are often used for the control of hydraulic problems caused by runoff, but they also serve a complementary purpose in the treatment of runoff water. Types of basins discussed include the following; dry basins, permanent basins, and absorption basins. (Moore-IVI)
W84-04000

MEANS ALLOWING TO REDUCE THE POLLUTION CAUSED BY RUNOFF WATER IN COMBINED AND SEPARATE DRAINS. A BIBLIOGRAPHIC SYNTHESIS, PART V (MOYENS D'ACTION POUR LIMITER LA POLLUTION DUE AUX EAUX DE RUISSELLEMENT EN SYSTEME SEPARATIF ET UNITAIRE. SYNTHESE BIBLIOGRAPHIQUE, PART V),
J. Ranchet, and Y. Ruperd.
Tribune du Cebedeau, Vol. 36, No. 474, p 219-238, 1983. 12 Fig, 3 Tab, 164 Ref.

Descriptors: *Water pollution control, *Runoff, *Combined sewers, Settling basins, Automation, Storm runoff, Wastewater treatment.

Methods actually used or under study for use in controlling pollution from runoff water are discussed in this bibliographic synthesis. This part consists of a review of methods to improve the function of networks, including selection of the type of storm basin, automation of the networks, and treatment of storm overflow alone. The study emphasizes the gaps in present knowledge in the field of pollution control for runoff water. References for all five parts are provided. (Moore-IVI)
W84-04001

AERATOR-BOAT PROJECT APPLICATION TO THE SAMBRE REAERATION (PROJET DE BATEAU AERATEUR APPLICATION A LA REAERATION DE LA SAMBRE),
For primary bibliographic entry see Field 5G.
W84-04002

WATER TREATMENT FOR THE HOME OR COTTAGE,
Environmental Health Directorate, Ottawa (Ontario).
R. S. Tobin.
Canadian Journal of Public Health, Vol. 75, No. 1, p 79-82, January/February, 1984. 2 Tab, 19 Ref.

Descriptors: *Water treatment, Water quality, Water treatment devices, Disinfection, Ceramic candles, Chlorinators, Distillers, Iodinators, Ozonators, Ultraviolet light, Activated Carbon, Greensand filters, Particulate filters, Reverse osmosis, Water softening.

Many types of water treatment devices are available for home or cottage use. Various devices can be selected to disinfect, soften, clarify, and remove undesirable chemicals, tastes and odors. It is important to understand the limits of a particular type of water treatment device and to match its features and capacity to the specific water quality problem to be solved. Performance testing may be required in order to demonstrate the efficacy and life expectancy of the device on various water types. For

disinfection of water to serve the whole house, chlorinators and ultraviolet light devices are the most practical techniques. Ceramic candles, iodinators and ozonators are currently considered the most suitable devices for treating tap water to be used only for drinking and cooking purposes. Distillers can be purchased for either batch or continuous treatment of water and are suitable for use wherever electrical power is present and where sufficient space exists to house the apparatus. For the removal of chemicals and generally improving water quality activated carbon, chlorination, distillers, greensand filters, particulate filters, reverse osmosis and softeners can be used with reasonable efficiency. (Murphy-IVI)
W84-04015

SEPTAGE DISPOSAL IN WASTE RECYCLING PONDS,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Environmental Engineering.
C. Polprasert, S. Udom, and K. H. Choudry.
Water Resources, Vol. 18, No. 5, p 519-528, 1984. 5 Fig, 6 Tab, 33 Ref.

Descriptors: *Septic sludge, *Wastewater disposal, *Recycling ponds, Ponds, Recycling, Algae, Fish, Bacteria, Bacteriophage, Septic tank, Septic wastewater, Wastewater treatment, Water reuse.

With the current energy crisis, the concept of waste recycling rather than simply waste treatment has received wide attention because the recycling or reuse of waste, besides increasing food and energy production, will reduce pollution and disease transfer, if carried out properly. The feasibility of septic tank sludge (septage) disposal into pilot-scale waste recycling ponds for the production of algae and fish is investigated. A septage loading of 100 kg COD/ha/day to four 4-sq m single-stage ponds resulted in the production of algal biomass and dissolved oxygen in the pond water, suitable for Tilapia growth. Some microbiological investigations of this waste recycling scheme were undertaken using ten earth ponds (each with the dimensions of 20 x 10 x 1.3 m: length x width x depth). The densities of coliform bacteria and bacteriophages in the pond water and sediment tended to increase with increased septage loadings and loading periods. The ponds fed with septage at the loading of 100 kg COD/ha/day were found to contain higher densities of these microorganisms than those of the control pond without septage feeding. The possible public health impact resulting from this practice was assessed. (Murphy-IVI)
W84-04018

COLOUR AND TURBIDITY REMOVAL WITH REUSABLE MAGNETITE PARTICLES-VII, A COLLOID CHEMISTRY STUDY OF THE EFFECT OF INORGANIC IONS ON THE EFFICIENCY OF CLARIFICATION,
Commonwealth Scientific and Industrial Research Organization, South Melbourne (Australia). Div. of Chemical Technology.
D. R. Dixon.
Water Resources, Vol. 18, No. 5, p 529-534, 1984. 11 Fig, 1 Tab, 10 Ref.

Descriptors: *Color removal, *Turbidity removal, *Magnetite, *Colloid Chemistry, *Clarification, Chemical properties, Electrochemistry, Ions, Cations, Anion, Electrolytes, Electrophoresis, Hardness, Wastewater treatment, Melbourne, Australia.

The removal of color and turbidity from natural waters by the addition of magnetite is an interfacial process. Furthermore the components of this system are either of colloidal dimensions or of a surface active nature and thus this method of water clarification is very much in the realm of surface and colloid chemistry. Electrokinetic techniques have been used to examine the influence of a number of inorganic species, commonly encountered in the practical situation, on the surface properties of magnetite and consequently on the efficiency of the process. Sodium, potassium, chloride, nitrate and sulfate ions are not strongly adsorbed by magnetite and act only as indifferent electrolytes. The multivalent cations, calcium, aluminum and zinc adsorb strongly, and markedly affect the surface properties of magnetite. For Ca(2+), which does not hydrolyze in the adsorption pH range, specific adsorption occurs, whereas for hydrolyzed cations, electrostatic forces prevail. Phosphate anions are also strongly and specifically adsorbed. From a practical viewpoint, the jar test experiments showed that ionic strength is of importance in regeneration. The presence of small concentrations of heavy metal ions does not affect clarification efficiency and, indeed, magnetite can be used for recovery of heavy metal ions, from effluents. Magnetite can also be used to remove phosphate from effluents. The presence of significant levels of hardness in a feedwater could necessitate changes to the process. (Murphy-IVI)
W84-04019

EFFECTS OF ORGANOTIN ON THE ACTIVATED SLUDGE PROCESS,
AWARE, Inc., Nashville, TN.
Y. Argaman, C. E. Hucks, and S. E. Shelby, Jr.
Water Resources, Vol. 18, No. 5, p 535-542, 1984. 2 Fig, 6 Tab, 9 Ref.

Descriptors: *Organotin, *Activated sludge process, Toxicity, Tributyl tin oxide, Continuous loading, Transient loading, Wastewater treatment, Biological wastewater treatment.

Organotin compounds which find increasing use in marine antifouling paints may be present in the discharge from dry dock operations. This investigation was aimed at determining the effect of such wastewater when discharged to a municipal activated sludge treatment plant. Experiments were conducted using a Warburg respirometer and continuous flow bench-scale activated sludge systems. Unacclimated biological cultures can be inhibited by tributyl tin oxide TBTO concentrations as low as 25 microg/l. However, TBTO doses of over 8000 microg/l can be tolerated by a well acclimated culture. Continuous loading of up to 1000 microg/l TBTO had no effect on organic removal in activated sludge systems. However, an adverse effect on sludge settleability was noticed at 100 microg/l TBTO. Shock loadings of 500 and 1000 microg/l TBTO had no effect on soluble organic removal but resulted in impaired settling and higher effluent suspended solids. The LC50 of TBTO to the fathead minnow was estimated at 45-200 microg/l. The toxicity was reduced considerably by activated sludge treatment. (Murphy-IVI)
W84-04020

PREDICTING ACTIVATED SLUDGE PHOSPHORUS REQUIREMENTS,
Texas Univ. at Arlington.
C. E. Parker, and S. P. Jones.
Journal of Environmental Engineering, Vol. 109, No. 1, February, 1983.

Descriptors: *Phosphorus requirements, *Activated sludge, Prediction, Wastewater treatment, Phosphorus, Organic carbon, Biological oxygen demand, Chemical oxygen demand.

Where receiving waters have strict phosphorus standards, the treatment of phosphorus deficient waste by biological oxidation may not be considered as a viable treatment alternative due to the inability to adequately predict the phosphorus requirements of the biomass. Without a rapid and easy means of establishing phosphorus requirements underestimating, which would adversely affect process operations, or overestimating, which would result in the unnecessary release of phosphorus into the receiving waters, would exist. The objective of this work was to relate established operational parameters of the activated sludge process to the phosphorus requirements of the biomass under aeration. In addition the formulation of a relationship that can be used by the operator in day-to-day operation, was also desired. (Murphy-IVI)
W84-04051

ACCUMULATION OF HEAVY-METAL IONS BY ZOOGLOEA RAMIGERA,
Lund Univ. (Sweden). Dept. of Technical Microbiology.
A. B. Norberg, and H. Persson.
Biotechnology and Bioengineering, Vol. 26, No. 3, p 239-246, March, 1984. 10 Fig, 2 Tab, 17 Ref.

Descriptors: *Heavy metals, *Zoogloea, *Biosorbents, *Biological wastewater treatment, Industrial wastes, Waste recovery, Polysaccharides, Copper, Cadmium, Uranium, Hydrogen ion concentration.

Using microorganisms as biosorbents for heavy metals offers a potential alternative to existing methods for detoxification and for recovery of toxic or valuable metals from industrial discharge water. Zoogloea ramigera, common in sewage plants, produces substantial amounts of extracellular polysaccharide when cultivated on a medium containing carbon source in excess. Biomass has been produced from glucose using Z. ramigera 115, and the biomass has been used to remove copper, cadmium, and uranyl ions from water solutions. The metal uptake was studied with two different methods: either by spectrophotometric measurements on the solutions after flocculation or by potentiometric measurements with amalgam electrodes in order to follow the entire complex formation. The metal-biopolymer interaction in 0.1 M NaClO4 is practically the same as when no neutral salt is added. The uptake and release phases are rapid; within 15 min or less the processes are completed. It is possible to produce biomass at a moderate cost using Z. ramigera. The separation step is rapidly performed by flocculation followed by centrifugation, but sedimentation by gravity alone can be used. The adjustment of pH can be used as a tool for obtaining selective metal uptake. Uranium is effectively adsorbed to the biomass at pH values around 3.5, copper around pH 5.5, and cadmium at pH 6.5. (Moore-IVI)
W84-04120

OPTIMIZATION OF OZONATION AND BIOLOGICAL ACTIVATED CARBON (BAC) IN A WATER RECLAMATION CONTEXT,
National Inst. for Water Research, Pretoria (South Africa).
J. van Leeuwen, J. Prinsloo, and R. A. van Steenderen.
Ozone: Science and Engineering, Vol. 5, No. 3, p 171-181, 1983. 4 Fig, 9 Tab, 11 Ref.

Descriptors: *Reclaimed water, *Ozonation, *Filtration, *Activated carbon, *Biological activated carbon, Effluents, Activated sludge process, Chemical oxygen demand.

When BAC was used in reclaiming water from activated sludge, it was normally exhausted after three months of operation, at a stage when the COD removed fell below 20% of the influent value to the BAC. A pilot plant study was carried out to find the ozone dosage which would cost-effectively extend the operational period of the BAC while maintaining a COD removal of at least 20% for the combined process units of ozonation, filtration and BAC. Cost figures were calculated for a 5,000 cu m/d plant under South African conditions, making provision for the capital amortization, maintenance and operational cost of ozonation, filtration and BAC. An ozone dosage of about 4 mg/l before filtration and BAC led to the most cost-effective COD removal in the reclamation of water from activated sludge effluent. The combination of ozonation, filtration and BAC could maintain a least COD removal fraction of 30% for more than three times as long an inter-reactivation period as for filtration and BAC without ozonation. Filtration has not been found to contribute significantly to the COD removal by the above combination of process units. (Moore-IVI)
W84-04174

5E. Ultimate Disposal Of Wastes

U.S. GEOLOGICAL SURVEY RESEARCH IN RADIOACTIVE WASTE DISPOSAL - FISCAL YEAR 1981,

Geological Survey, Reston, VA. Water Resources Div.
R. Schneider, and N. J. Trask.
USGS Water-Resources Investigations Report 83-4105, 1983. 122 p, 19 Fig, 3 Tab.

Descriptors: *Radioactive waste disposal, *Nuclear wastes, *Radioactive wastes, Wastes.

The report summarizes progress on geologic and hydrologic research related to the disposal of radioactive wastes. The research is described according to whether it is related most directly to (1) high-level and transuranic wastes; (2) low-level wastes, or (3) uranium mill tailings. Included is generic research, applicable to the identification and geohydrologic characterization of waste-disposal sites, to investigations of specific sites where wastes have been stored, and to studies of regions or environments where waste-disposal sites might be located. A significant part of the activity is concerned with techniques and methods for characterizing disposal sites and studies of geologic and hydrologic processes related to the transport and/or retention of waste radionuclides. (USGS)
W84-03553

LAND APPLICATION OF WASTEWATER AND ITS EFFECT ON GROUND-WATER QUALITY IN THE LIVERMORE-AMADOR VALLEY, ALAMEDA COUNTY, CALIFORNIA,
Geological Survey, Menlo Park, CA. Water Resources Div.
M. A. Sylvester.
USGS Water-Resources Investigations Report 82-4100, March, 1983. 53 p, 6 Tab, 17 Fig, 13 Ref.

Descriptors: *Land application, *Wastewater, *Water quality, *Groundwater, Effluents, Livermore-Amador Valley, Alameda County, *California.

Ground-water quality, ground-water level, and rainfall data collected during the 1975 water year through the 1980 water year were analyzed to determine the effects of land application of effluent from wastewater treatment plants on ground-water quality in the Livermore-Amador Valley. Annual rainfall varied markedly during the study: 1976 and 1977 water years had less than one half the normal rainfall; 1978 and 1980 water years had greater than normal rainfall; and 1975 and 1979 water years had nearly normal rainfall. The direction ground-water movement in the valley was found to be generally that of surface water. Dissolved nitrate concentrations were generally much less in areas not receiving wastewater applications than in areas that do. Specific conductance, dissolved solids, dissolved chloride, and dissolved nitrate were substantially less in the lower aquifers than in the upper aquifer in the Livermore wastewater application areas. In the Castlewood, Pleasanton, Veterans Administration Hospital, and Livermore wastewater applications areas ground-water quality was similar to the quality of effluent from wastewater treatment plants in the valley. Rainfall, soil, and geology appeared to be the main determinants of ground-water quality in the Castlewood and Dublin-San Ramon and Camp Parks Military Reservation areas. Wastewater application appeared to be the main determinant of ground-water quality in Pleasanton, Veterans Administration Hospital, and Livermore Municipal Airport areas. Comparison of ground-water quality in wastewater application areas with proposed State water-quality objectives for ground water in the Livermore-Amador Valley showed impaired water quality in all areas. (USGS)
W84-03573

PULP AND PAPER SLUDGE DISPOSAL: THE PROBLEM, CURRENT PRACTICE AND FUTURE DIRECTIONS,
Maine Univ. at Orono. Dept. of Civil Engineering.
C. A. Rock, and J. A. Alexander.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84-154426, Price codes: A03 in paper copy, A01 in microfiche. Land and Water Resources Center Completion Report, September, 1983. 35 p, 2 Fig, 5 Tab, 72 Ref. Project No. OWRT A-057-ME(4), Contract/Grant No. 14-34-0001-2121.

Descriptors: *Sludge utilization, *Wastewater, *Sludge disposal, Pulp and paper industry, Sludge, Pulp wastes, *Maine, Industrial wastewater.

The 1976 requirement for secondary treatment of pulp and paper mill wastewater has dramatically improved the quality of Maine rivers, but it has also created a new pollution problem, that of sludge disposal. A statewide survey of Maine pulp and paper mills showed that over one million pounds (537 dry tons) of wastewater solids were generated daily. Analyses of the sludges showed a substantial variation from mill to mill, reflecting the mix of raw materials and the different pulping processes used. The data showed that industry-generated sludges had low levels of heavy metals and no pathogens, in contrast to municipal sludges. Nearly all (93 percent) of the sludges generated by Maine mills are disposed of by landfilling. The remaining seven percent are incinerated. Alternative sludge disposal and utilization technologies, including those presented at the symposium 'Long Range Disposal Alternatives for Pulp and Paper Sludges' (Bangor, Maine, October 1982) were reviewed. Each alternative was evaluated in light of Maine conditions. While sludge variability precluded one universal solution, several methods were identified as feasible. Some may provide only seasonal solutions, but each can contribute to solving the industry's sludge management problems.
W84-03670

STUDY OF THE POLLUTION POTENTIAL OF LAND-SPREAD SEPTAGE,
Oregon State Univ. Extension Service, Corvallis.
For primary bibliographic entry see Field 5B.
W84-03722

GROUNDWATER-FLOW PARAMETER ESTIMATION AND QUALITY MODELING OF THE EQUUS BEDS AQUIFER IN KANSAS, U.S.A.,
Kansas State Geological Survey, Lawrence.
For primary bibliographic entry see Field 2F.
W84-03784

USE OF STABILIZATION PROCESSES IN THE CONTROL OF TOXIC WASTES,
Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
C. S. Poon, C. J. Peters, and R. Perry.
Effluent and Water Treatment Journal, Vol. 23, No. 11, p 451-459, November, 1983. 2 Fig, 9 Tab, 45 Ref.

Descriptors: *Wastewater treatment, *Waste disposal, Stabilization, Hazardous materials, Clay, Lime, Cement, Chemical reactions, Polymers.

Stabilization is a pre-treatment process that induces chemical change to a waste to form insoluble compounds that entrap toxic elements or compounds in an impervious polymer or stable crystal lattice. Stabilization-solidification processes are classified as fixation processes based upon cement, lime and clay together with encapsulation techniques that use specific organic polymers. Stabilization/solidification methods offer several advantages including improvement in the handling characteristics of the waste while producing a solidified material with sufficient strength to allow for land reclamation. The modified structure significantly reduces the leachability by decreasing the modility and surface are of the waste exposed. Cement based fixation is a process which incorporate the waste as part of a rigid cement matrix. Lime based processes use lime in combination with pozzolanic materials to produce cementitious matrices which chemically and physically entrap the waste. Clay-based fixation uses clay minerals with their cation-exchange capacity and extensive specific surface in combination with a setting agent for the fixation of hazardous wastes. Thermoplastic encapsulation, thermosetting micro-encapsulation, and macro-encapsulation use organic polymers to isolate waste materials. (Baker-IVI)
W84-03884

DETERMINING SLUDGE FERTILIZATION RATES FOR FORESTS FROM NITRATE-N IN LEACHATE AND GROUNDWATER,
North Central Forest Experiment Station, East Lansing, MI.
D. G. Brockway, and D. H. Urie.
Journal of Environmental Quality, Vol. 12, No. 4, p 487-492, 1983. 5 Fig, 4 Tab, 22 Ref.

Descriptors: *Sludge disposal, *Fertilization, *Forests, *Leachate, *Groundwater, Groundwater pollution, Coniferous forests, Soil water, Water quality, Municipal wastewater, Pulp wastes.

To meet Federal secondary treatment standards for wastewater descharge, states in the Great Lakes Region must dispose of increasing volumes of sludge in a manner that will not degrade environmental quality nor endanger public health. Applying these residual wastes to land has been identified as a major, cost-effective solution to this problem. Municipal and papermill wastewater sludges were applied to conifer and hardwood forests growing on sandy soils (Entic Haplorthods, Spodic Udipsamments, and Alfic Haplorthods), in northwestern Lower Michigan where annual precipitation averages 765 mm/y, to investigate the impact of sludge on nitrate-N concentrations in soil water and groundwater. During the first growing season after treatment, all forms of N in groundwater and soil water remained near background levels except under aspen (Populus grandidentata Michx.) plots treated with 46 dry Mg municipal sludge/ha. Following the first spring snowmelt period after sludge was applied (spring 1977), nitrate-N concentrations exceeded the 10 mg/L potable water standard in groundwater under plots treated with 16 or more dry Mg/ha undigested papermill sludge. Soil leachate exceeded 10 mg/L under pine plantations receiving 19.3 dry Mg/ha and aspen sprout stands receiving 23 dry Mg/ha or more anaerobically digested municipal sludge. Sludge application rates which would not degrade water quality in water-table aquifers were estimated by regression analysis of nitrate concentrations in relation to dry solids loading. Applying raw papermill sludge at rates not exceeding 9.5 dry Mg/ha (670 kg total N/ha) to a red pine (Pinus resinosa Ait.) plantations was found to be consistent with levels that met the 10 mg/L potability standard in groundwater. These analyses showed anaerobically digested municipal sludge could be applied to a red pine and white pine (Pinus strobus L.) plantation at 16.5 dry Mg/ha (990 kg total N/ha) or less and to aspen sprouts at rates up to 19 dry Mg/ha (1140 kg total N/ha) with the same water quality limits. (Murphy-IVI)
W84-03927

PLANNING MODEL FOR LAND APPLICATION OF SEWAGE SLUDGE,
Cornell Univ., Ithaca, NY.
D. A. Haith.
Journal of Environmental Engineering, Vol. 109, No. 1, p 66-81, February, 1983. 5 Fig, 5 Tab, 19 Ref.

Descriptors: *Sludge disposal, *Land disposal, *Nitrates, *Mathematical models, Percolation, Leaching, Mineralization, Ammonia, Volatilization, Crop uptake.

A simple mathematical model is presented for estimating nitrate-nitrogen concentrations in percolation from sludge land application sites. The model is based on annual mass balances of sludge and soil inorganic nitrogen and includes the processes of mineralization, ammonia volatilization, crop uptake, and leaching. Most input parameters are readily obtained from published sources and standard sludge analyses. Default values are given for the three remaining parameters, which describe ammonia volatilization and nitrogen mineralization. Model predictions compared favorably with field measurements taken over three years in a previous study. The model is generally limited to sites for which the annual water surplus is sufficient to leach all inorganic nitrogen from the root zone. The model also neglects denitrification losses, and may produce conservative over-predictions of nitrate leaching. The model is particularly well-suited to the evaluation of long-term charac-

teristics of sludge and application sites. (Moore-IVI)
W84-04045

5F. Water Treatment and Quality Alteration

ALGAE SEPARATION BY DISSOLVED AIR FLOTATION,
Lenox Inst. for Research, Inc., MA.
For primary bibliographic entry see Field 5D.
W84-03673

DEVELOPMENT OF ALTERNATIVE STERILIZATION METHODS,
Lenox Inst. for Research, Inc., MA.
L. K. Wang, and A. E. Thayer.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-225052. Technical Report No. LIR/07-83/1, July 1, 1983. 17 p, 5 Tab, 4 Ref. Project No. L8301001-T, Contract/Grant No. R81P01-B.

Descriptors: *Sterilization, Bacteria, Coliform, *Microwave, Oven, *Pressure cooker, Analytical methods, Mobile laboratory.

Tests run on various water samples containing bacteria indicate that an alternative Microwave-Pressure Cooking method for sterilization of apparatus and materials may be used in mobile laboratories. The proposed sterilization method and the standard sterilization method produced equivalent results. Phosphate buffer and nutrient media plates were run as controls and throughout the experimentation produced no bacterial growth. Microwaving may be used alone to sterilize glassware and some thermal proof plastics. The recommended operational conditions are: highest power setting for 25 minutes. Pressure cooker alone is feasible for sterilization of phosphate buffer, dilution water, and for preparation of bacteria-free water which, in turn, can be used for preparing nutrient media. The recommended operational conditions are: 15 lbs pressure for at least 15 minutes at 100 degrees C. The combination of a microwave oven and a pressure cooker can be an ideal substitute for an expensive autoclave which is being used for sterilization in large medical and water quality control laboratories.
W84-03674

WATER LEVELS OF TRIHALOMETHANES (THM) IN FOUR DIFFERENT SUPPLY SYSTEMS FROM SAO PAULO STATE, (BRAZIL),
Companhia de Tecnologia de Saneamento Ambiental, Sao Paulo (Brazil).
N. A. G. G. de Fernicola, and F. A. de Azevedo.
Journal of Environmental Health, Vol. 46, No. 4, p 187-188, January/February, 1984. 1 Tab, 14 Ref.

Descriptors: *Water quality, *Trihalomethanes, *Water supply, *Brazil, *Sao Paulo, Water quality control, Drinking water, Water treatment facilities, Chlorination.

During winter-spring of 1980 samples of water from four supply systems were obtained both before and after chlorination at the treatment stations within Greater Sao Paulo, Brazil. They were analyzed for CHCl3, CHCl2Br, CHClBr2 and CHBr3. Trihalomethanes (THM) were not found in raw water of the four main supply systems. Considerable amounts of total THM were found in drinking water from the four systems after chlorination (0.10, 0.07, 0.07, and 0.13 mg/l, respectively). Total THM levels continuously increased from the treatment station to the tap. The supply sytems which showed higher levels of total organic chlorine in the raw waters were also the ones which showed higher levels of THM in the treated tap water. (Baker-IVI)
W84-03723

ARSENIC AND FLUORIDE REMOVAL FROM GROUNDWATER BY REVERSE OSMOSIS,
Kennedy/Jenks Engineers, San Francisco, CA.
R. W. Schneiter, and E. J. Middlebrooks.
Environment International, Vol. 9,, No. 4, p 289-292, 1983. 2 Tab, 7 Ref.

Descriptors: *Groundwater management, *Reverse osmosis, *Fluoride, *Arsenic, Groundwater, Water quality control, Utah, Deseret.

Data are reported from experiments considering removal of naturally occurring fluoride and arsenic from the Deseret, Utah anaerobic groundwater. The groundwater samples were collected from a private well that had been identified as containing arsenic and fluoride concentrations approaching or exceeding the MCL (maximum contaminant levels). Arsenate removals by reverse osmosis approaching 90% were attained for feedwater arsenic concentrations close to 100 micrograms/L. For the same feedwater arsenic concentrations, arsenate removals of only 58% were attained. The maximum contaminant levels for arsenic were satisfied regardless of the arsenic species dominating. Chlorination disinfection oxidized the arsenite to arsenate. Although the feedwater fluoride concentrations were 1.7 and 1.8 mg/L for experimental run 1 and 2, respectively, a 59-67% reduction of fluoride concentration was observed. (Baker-IVI)
W84-03892

CHARACTERISTICS OF A GENERAL MATHEMATICAL MODEL OF WATER-QUALITY MANAGEMENT IN LARGE RESERVOIRS,
For primary bibliographic entry see Field 2H.
W84-03912

MUTAGENIC AND CLASTOGENIC EFFECTS OF ORGANIC EXTRACTS FROM THE ATHENIAN DRINKING WATER,
National Hellenic Research Foundation, Athens (Greece). Biological Research Center.
For primary bibliographic entry see Field 5C.
W84-03993

STUDY ON CHLORINE DISINFECTION OF POND EFFLUENT,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Environmental Engineering.
C. Polprasert, and V. S. Rajput.
Water Resources, Vol. 18, No. 5, p 513-518, 1984. 6 Fig, 1 Tab, 21 Ref.

Descriptors: *Chlorine, *Disinfection, *Stabilization ponds, Fecal coliforms, Coliforms, Algae, Mathematical model, Contact stabilization, Wastewater treatment.

Chlorine disinfection experiments were conducted to investigate the die-off patterns of the fecal coliforms when present in waste stabilization pond effluents containing from 100 to 400 mg/l algae. The fecal coliform inactivation was observed to occur at two rates, i.e. an initial rapid kill followed by a slower kill. The magnitude of inactivation was found to be proportional to the initial chlorine dose and contact time and inversely proportional to the algal concentration. A mathematical model was developed to predict the fecal coliform survival ratio during the chlorination of the pond effluent. When compared with the experimental data, the predicted results had a correlation coefficient of 0.981. (Author's abstract)
W84-04017

REMOVAL OF ORGANIC PRIORITY POLLUTANTS BY OXIDATION-COAGULATION,
Universidade Federal do Rio Grande do Sul, Porto Alegre (Brazil).
S. J. DeLuca, A. C. Chao, and C. Smallwood, Jr.
Journal of Environmental Engineering, Vol. 109, No. 1, p 36-46, February, 1983. 1 Fig, 5 Tab, 30 Ref.

Descriptors: *Water treatment, *Oxidation, *Coagulation, *Potassium ferrate, Flocculation, Priority pollutants, Bromodichloromethane, Trichloroethylene, Dichlorobenzene, Nitrobenzene, Naphthalene, Mathematical models.

The oxidation of a group of priority pollutants with different chemical structures and properties by the use of ferrate is studied. A comparison is made by the coagulation-flocculation of the oxidized pollutants by ferrate with alum coagulation using the jar test. The efficiency of removal of the pollutants by simple air and mechanical (paddle) flocculation is also studied. The pollutants studied are bromodichloromethane (BDCM), trichloroethylene (TCE), 1,2-dichlorobenzene (DCB), nitrobenzene (NB), and naphthalene (NAPH). It is shown that purification of water supply by coagulation with potassium ferrate and stripping with gas removes four out of five wastes listed as priority pollutants. Only nitrobenzene is unaffected. A mathematical model utilizing dipole momentum, solubility parameter and log activity coefficient predicts the efficiency of the process. (Author's abstract)
W84-04043

OPTIMIZING GAC SYSTEMS,
Municipal Environmental Research Lab., Cincinnati, OH. Drinking Water Research Div.
R. M. Clark.
Journal of Environmental Engineering, Vol. 109, No. 1, p 139-156, February, 1983. 6 Fig, 6 Tab, 8 Ref, 1 Append.

Descriptors: *Activated carbon, *Granular activated carbon, *Water treatment, *Cost analysis, Organic compounds, Mathematical equations, Optimization, Adsorbents.

Granular Activated Carbon (GAC) is an effective technique for removing synthetic organics from both ground and surface waters, but questions have been raised over the cost of using GAC in this manner. A series of cost curves for various unit processes including those related to GAC are modified into continuous analytic equations. The equations can be used to estimate total unit costs, and to examine those variables to which the cost of GAC systems are most sensitive. Based on activated carbon use rate, bigger is not better. If the use rate is decreasing with empty bed contact time (EBCT), then larger volumes or greater EBCT's yield lower cost. When activated carbon use rate becomes constant, deeper beds result in higher cost. Cheaper activated carbon could mean higher activated carbon losses and more frequent reactivation. Regional reactivation may result in lower costs, particularly for smaller utilities. Even when optimized, GAC is a relatively expensive technology and should be used only when there are no alternatives. (Moore-IVI)
W84-04047

OPTIMIZATION OF GRAVITY-FED WATER DISTRIBUTION SYSTEMS: THEORY,
Visvesvaraya Regional Coll. of Engineering, Nagpur (India).
P. R. Bhave.
Journal of Environmental Engineering, Vol. 109, No. 1, p 189-205, February, 1983. 4 Fig, 3 Tab, 23 Ref, 1 Append.

Descriptors: *Water conveyance, *Water distribution, *Optimization, *Gravity-fed systems, Linear programming, Feasibility, Network design.

A theory is developed for the optimization of multisource, looped, gravity-fed water distribution systems subjected to a single loading pattern. The method is based on linear programming (LP) techniques and produces a locally optimal solution. Design feasibility constraints are derived to check whether network design and therefore network optimization is feasible. The design feasibility constraints are comprised of the network demand constraint, group demand constraints, and transportation constraints. When the transportation constraints are satisfied, other constraints are automatically satisfied. It is preferable to check the design feasibility constraints in the order in which they are derived as this avoid checking the complicated transportation constraints if the earlier simpler constraints are not satisfied and the design is not feasible. Based on classical transportation problem principles, a theory is developed to formulate an LP problem for obtaining design paths from the source nodes to the demand nodes and thereby for

obtaining the design distribution graph for the entire distribution system. Separate LP optimization models are then formulated to deal with the either the D-specific condition in which the nonprimary links are of some minimum or specified diameter, or the Q-specified condition in which the nonprimary links carry some minimum or specified discharge. (Moore-IVI)
W84-04049

FIELD MONITORING OF CHRYSOTILE ASBESTOS IN CALIFORNIA WATERS,
California Dept. of Health Services, Berkeley. Air and Industrial Hygiene Lab. Section.
For primary bibliographic entry see Field 5B.
W84-04087

SUBSTRATE UTILIZATION BY AN OXALATE-CONSUMING SPIRILLUM SPECIES IN RELATION TO ITS GROWTH IN OZONATED WATER,
Keuringsinstituut voor Waterleidingartikelen, Rijswijk (Netherlands).
D. van der Kooij, and W. A. M. Hijnen.
Applied and Environmental Microbiology, Vol. 47, No. 3, p 551-559, March, 1984. 7 Fig, 5 Tab, 23 Ref.

Descriptors: *Ozonation, *Carboxylic acids, *Spirillum, Biodegradation, Water treatment, Oxalic acid.

Ozonation of water containing organic compounds which are resistant to biodegradation results in the formation of a number of easily biodegradable carboxylic acids. An attempt was made to develop a microbiological method to quantify the presence of the easily biodegradable carboxylic acids, including oxalic acid. The nutritional versatility of a vibrio-shaped, oxalate-utilizing isolate, strain NOX, obtained from tap water supplied with low concentrations of formate, glyoxylate, and oxalate, was determined by growth experiments with low-molecular-weight carbon compounds at high (grams per liter) and very low (micrograms per liter) concentrations. Strain NOX was isolated from the filtrate of slow sand filters of the Municipal Dune Waterworks, The Hague (Netherlands). The organism, identified as a Spirillum species, appeared to be specialized in the utilization of a number of carboxylic acids. Yields of 2,900,000 CFU/micro g of oxalate C and 12,000,000 CFU/micro g of acetate C were obtained from growth experiments in tap water supplied with either oxalate or acetate. A substrate saturation constant of 0.64 micro M oxalate was calculated for strain NOX. Maximum colony counts of strain NOX grown in ozonated water (dosages of 2.0 to 3.2 mg of O3 per liter) were 15 to 20 times larger than in maximum colony counts of strain NOX grown in water before ozonation. Oxalate concentrations were calculated from the maximum colony counts of strain NOX grown in samples of ozonated water in which a non-oxalate-utilizing strain of Pseudomonas fluorescens had already reached maximum growth. The oxalate concentrations obtained by this procedure ranged from 130 to 220 micro g of C/liter. (Moore-IVI)
W84-04119

INVESTIGATIONS ON THE CHANGES OF BIOLOGICAL DEGRADABILITY OF SINGLE SUBSTANCES INDUCED BY OZONATION,
Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Radiochemie.
E. Gilbert.
Ozone: Science and Engineering, Vol. 5, No. 3, p 137-149, 1983. 16 Fig, 9 Ref.

Descriptors: *Water treatment, *Ozonation, *Biodegradation, Drinking water, Carbon filters, Oxidation, Aniline, Benzene sulfonic acid, Cresols, Humic acid, Biological treatment, Aromatic compounds.

Toxic or difficulty degraded substances can be converted, by means of ozonolysis, to biologically active groups of substances, but an excess of ozone of 3-6 g O3/g DOC is necessary. Water works generally employ doses of 1-2 g O3/g DOC, which may be the reason for the observed destruction of biological activities in carbon filters, since at low doses the dissolved substances may be only partially oxidized or poorly degradable intermediate products may be formed. The ozonolysis of some model compounds was performed. The reactions of aniline, benzene-sulfonic acid, 4-chloro-o-cresol, 2-nitro-p-cresol and humic acid with ozone show that after low ozone doses (1 g O3/g DOC) the products formed are not biodegradable as in the case of aniline (BOD5/COD = 0.05) or that the intermediate products are not much easier to degrade than the initial substances. BOD5/COD values of 0.05 - 0.25 were found. With low doses of ozone used in drinking water works the substituted aromatics are only partly degraded. Non-biodegradable intermediates are formed, which are converted to stable biodegradable oxidation products by higher ozone doses. (Moore-IVI)
W84-04172

OZONATION OF SOME AROMATIC COMPOUNDS IN AQUEOUS SOLUTION: STYRENE, BENZALDEHYDE, NAPHTHALENE, DIETHYLPHTHALATE, ETHYL AND CHLORO BENZENES,
Poitiers Univ. (France). Lab. de Chimie de l'Eau et des Nuisances.
B. Legube, S. Guyon, H. Sugimitsu, and M. Dore.
Ozone: Science and Engineering, Vol. 5, No. 3, p 151-170, 1983. 20 Fig, 1 Tab, 20 Ref.

Descriptors: *Aromatic compounds, *Ozonation, *Drinking water treatment, *Styrene, *Benzaldehyde, *Naphthalene, *Diethylphthalate, *Ethylbenzenes, *Chlorobenzenes, Surface waters, Oxidation, Gas stripping.

Many simple aromatic compounds found in surface waters can be removed by ozone in the process of drinking water treatment. Ozonation of some of the aromatic compounds frequently found in French surface waters was studied in an aqueous medium. As far as the reactivity is concerned, the values of the ozone consumed per initial aromatic consumed (molar ratio ozone demand), were determined in a semi batch bubble column at slightly acidic pH. As for the ozonation products, the application of specific experimental procedures in high concentration aqueous solution after the use of derivatization reactions, allowed the isolation (PLC, GC) and identification (GC/MS ; MS, NMR) of some degradation products in the cases of benzaldehyde and naphthalene. The development, in dilute aqueous solution, of some ozonation products (HPLC, GC), is followed for styrene, benzaldehyde, naphthalene and diethylphthalate. The mechanisms of initial steps of ozonation are examined in the case of styrene, of benzaldehyde and of naphthalene. It was not possible to isolate the ozonation products of chlorobenzenes and ethylbenzenes. The ozonated gas stripping of these compounds was more significant. (Moore-IVI)
W84-04173

5G. Water Quality Control

ARE CHANGES IN PHYTOPLANKTON ASSEMBLAGES OF PIBURGER SEE CONSEQUENCES OF HYPOLIMNETIC WATER REMOVAL (SIND DIE VERANDERUNGEN IM PHYTOPLANKTONBILD DES PIBURGER SEES AUSWIRKUNGEN DER TIEFENWASSERABLEITUNG),
Innsbruck Univ. (Austria). Botanisches Inst.
E. Rott.
Archiv fur Hydrobiologie, Suppl 67, No. 1, p 29-80, October, 1983. 10 Fig, 4 Tab, 77 Ref.

Descriptors: *Phytoplankton, *Species diversity, *Lake restoration, Trophic state, Eutrophication, Hypolimnion, Seasonal variation, Lake Piburger, Mesotrophic lakes, Hypolimnetic outlets.

Studies of seasonal and long-term periodicity of phytoplankton are used to characterize the development of Lake Piburger, a small meromictic and mesotrophic lake situated in a forested area. In order to avert fish-kill by complete oxygen depletion, a hypolimnetic outlet was introduced to enhance the export of oxygen-poor and nutrient rich water. Effects of the restoration measures on the phytoplankton periodicity are traced. Data on the relative abundance of the main taxonomic groups for each sampling depth and the respective weighted means in absolute figures give some general information on the successional pathway and the ecological demands of the main phytoplankton groups. Characteristic distribution patterns, which largely regulate the distribution of total biovolumes of phytoplankton are shown for bluegreen algae, green algae and Chrysophyceae. The seasonal periodicity of phytoplankton in Piburger See is following constant patterns due to a strong stratification tendency. The sequence of the annual means of phytoplankton demonstrates the increase of blue-green algae from 1972-75 and simultaneous increase of total biovolumes from 1972-76. It is difficult to relate this development to some form of internal eutrophication due to hypolimnetic water removal, since a second increase of blue-green algae and total biovolume has been observed in 1981 after 10 years functioning of the Olszewskitube and since primary productivity generally remained more or less constant. For the special mesotrophic situation of Piburger See the restoration measure used did not cause fundamental changes of seasonal and long-term periodicity of phytoplankton. (Baker-IVI)
W84-03507

PREVENTION OF ACID DRAINAGE FROM STORED COAL,
Tennessee Valley Authority, Chattanooga. Div. of Water Resources.
H. Olem, T. L. Bell, and J. J. Longaker.
Journal of Energy Engineering (ASCE), Vol. 109, No. 2, p 103-112, June, 1983. 2 Fig, 4 Tab, 10 Ref.

Descriptors: *Acidic water, *Drainage, *Coal, Storage, Wastewater treatment, Sodium lauryl sulfate, Leachates, Leaching, Cost analysis.

The most efficient method now used for storing large quantities of coal is placement on the ground. Because the coal is exposed to the elements, rainwater falling on the pile can become contaminated by the action of chemolithotrophic bacteria on pyritic materials (usually iron disulfides). A method has been identified for controlling acid production and subsequent dissolution of toxic pollutants in drainage from coal storage piles. Results of laboratory and field experiments indicate that it may be possible to prevent, rather than treat, acid drainage by periodically applying an environmentally safe detergent formulation to the coal. These experiments showed that a mild solution of sodium lauryl sulfate (SLS) effectively blocks the activity of the bacteria that promote acid formation and chemical leaching. Drainage from coal treated once with 50 mg/L of SLSf remained neutral for 60 days, about three times longer than the untreated control sample. An extrapolation of results to an industrial-scale application revealed that the cost of the SLS needed for a single application would likely be no more than $200 per acre of coal storage area ($500 per hectare) or, expressed per unit weight of coal, $4,000 per million metric tons. (Murphy-IVI)
W84-03714

RESERVOIR MANAGEMENT,
Waco Water Treatment and Pollution Control, TX.
M. D. Meadows.
Southwest and Texas Waterworks Journal, Vol. 65, No. 11, p 8-12, February, 1984. 3 Tab.

Descriptors: *Reservoir operation, *Water quality control, *Waco, *Texas, Watershed management, Taste, Odor, Algal control, Algicides, Copper sulfate, Destratification.

The first step in insuring the water consumer of the highest quality product possible is to implement a stringent reservoir management program. The characteristics of the reservoir will determine how to develop, evaluate, and use a particular management program at the location of the reservoir. Methods used in the city of Waco, Texas for

reservoir management since 1965 are reviewed. The program includes watershed monitoring, routine reservoir sampling, algae control methods and artificial destratification. The sampling involves testing for microbiological status as well as physical and chemical analyses. Sampling point locations were selected such that the data gained would produce information that tells what the condition of the water draining into the reservoir is, and the quality of the water exiting to the treatment facility. A destratification system is operated from March to October to control taste and odor problems. The watershed monitoring program includes the use of the routine sampling program as the first indicator of changes within the watershed. Visual observations included in the program consist of aerial surveys, land surveillance using automobiles, and water surveillance using boats. Copper sulfate is considered to be the most most generally accepted and effective algicide. (Baker-IVI)
W84-03801

LIMING OF ACIDIFIED SWEDISH LAKES AND STREAMS AND ITS CONSEQUENCES FOR AQUATIC ECOSYSTEMS,
Goeteborg Univ. (Sweden).
B. Hasselrot, and H. Hultberg.
Fisheries, Vol. 9, No. 1, p 4-9, January-February, 1984. 6 Fig, 29 Ref.

Descriptors: *Lime, *Acidic lakes, *Acidic streams, *Sweden, *Ecological effects, Neutralization, Water quality, Benthic fauna, Toxicity, Aluminum, Retention time, Lime application, Chemical properties.

Acidification of poorly buffered lakes, with negative effects on fish populations as well as the functioning of whole aquatic ecosystems, prompted an extensive program for neutralization of surface waters in Sweden. The biological response to lake liming has been mainly positive, especially in lakes with water retention times of more than 1-2 years, and in lakes where the deleterious effects of acidification have been moderate. Liming promotes decompositional processes. Whether it results in a temporary or permanent increase in nutrient recycling, is not yet known. The number of phytoplankton species generally increases in limed lakes. Zooplankton species which are sensitive to acidification reappear often spontaneously in limed lakes within a few years. The benthic fauna, established during the acid period, changes over several years following liming. New species invade during the neutral conditions and populations of acid sensitive species, previously present at very low levels, expand. The biomass of chironomids often decreases after neutralization. Reproduction and recruitment of fish have generally been successful in lakes where satisfactory water quality has been achieved. Toxicity to fish due to aluminum after liming has been reported. Liming techniques for lakes with short water retention times and especially for running waters, have not been fully developed in the Swedish liming program. The neutralized aquatic ecosystem is not a restored 'unpolluted' ecosystem. It is a new stage in the lake history, where organisms survive but are stressed by the continued input of acid drainage waters with elevated concentrations of metals. (Author's abstract)
W84-03808

WHOLE-LAKE NEUTRALIZATION EXPERIMENTS IN ONTARIO: A REVIEW,
W. A. Scheider, and T.G. Brydges.
Fisheries, Vol. 9, No. 1, p 17-18, January-February, 1984. 13 Ref.

Descriptors: *Water quality control, *Lake restoration, *Neutralization, Acidity, Heavy metals, Copper, Middle Lake, Lohi Lake, Hannah Lake, Nelson Lake, Sudbury, Ontario, Phosphorus, Fish behavior, Fisheries, Water pollution effects.

There are numerous lakes with low pH and elevated metal content in the Sudbury (Ontario) area because of the activities of the local mining and smelting industries. Techniques for improving water quality and subsequently the fisheries of four acidic, metal-contaminated lakes in the Sudbury area (Hannah, Middle, Lohi, and Nelson Lakes) were sought. All lakes were neutralized with Ca(OH)2 and CaCO3. Two lakes, Hannah and Middle, were fertilized 1-2 years after neutralization with low level additions of phosphorus. An immediate decline in phytoplankton standing stock followed neutralization, but levels returned to pretreatment values within a few months. The lakes were then stocked with fish, but extensive netting yielded no fish from either Lohi Lake nor Middle Lake. Mortality of the stocked species was attributed to waterborne Cu toxicity. (Baker-IVI)
W84-03809

IN SITU MANIPULATION OF WATER CHEMISTRY USING CRUSHED LIMESTONE AND OBSERVED EFFECTS ON FISH,
Ontario Ministry of Natural Resources, Toronto.
J. M. Gunn, and W. Keller.
Fisheries, Vol. 9, No. 1, p 19-24, January-February, 1984. 4 Fig, 3 Tab, 21 Ref.

Descriptors: *Fish, *Water quality control, *Limestone, *Acidity, Acid lakes, Ontario, Sudbury, Neutralization, Trout, Growth stages, Hydrogen ion concentration.

Limestone additions were made to acidic lakes near Sudbury, Ontario to create favorable microenvironments for early life stages of salmonids (trout). Substrate baskets containing as little as 15 kg crushed limestone neutralized interstitial water under acutely toxic conditions where pH levels were 4.6 and total aluminum was greater than 400 micrograms/liter. Neutralization of the water permitted high survival rates of incubating eggs and fry. Flow-through filter tanks and stream bed additions were used to neutralize flowing water with similar results. Both procedures produced significant changes in water chemistry including elevations in pH, alkalinity, conductivity and calcium content. A 345 tonne stream bed addition was largely ineffective at controlling springtime pH depressions but produced substantial annual increases in the downstream discharge of alkalinity. Small-scale treatments such as limestone covered spawning sites may be of remedial value in acidic systems. (Baker-IVI)
W84-03810

EXPERIMENT ON THE FEASIBILITY OF REHABILITATING ACIDIFIED ATLANTIC SALMON HABITAT IN NOVA SCOTIA BY THE ADDITION OF LIME,
Toronto Univ. (Ontario).
W. J. White, W. D. Watt, and C. D. Scott.
Fisheries, Vol. 9, No. 1, p 25-30, January-February, 1984. 6 Fig, 3 Tab, 15 Ref.

Descriptors: *Rehabilitation, *Habitats, *Salmon, *Nova Scotia, *Lime, Acid lakes, Hydrogen ion concentration, Chemical properties, Chemical treatment, Environmental effects, Mixing, Sandy Lake.

In 1981, the Department of Fisheries and Oceans carried out an experimental neutralization of an acidified lake in Nova Scotia. The purpose of this experiment was to determine whether lake liming could be used as a technique to control the pH of Atlantic salmon habitat downstream from the lake and to learn the proportion of lime which would be dissolved, the effects of liming on water chemistry, and the duration of these effects relative to the retention time of water in the lake. The experiment was carried out on Sandy Lake in the Sackville River system near the town of Bedford, Nova Scotia. Sandy Lake is 74 ha in area, 5,100,000 cu m in volume, and its retention time is 0.34 years. Its water chemistry was normal for lakes in the Halifax area and its pH was between 4.5 and 5.0 before lime was added. In July and August 1981, 135,000 kg of CaCO3 were mixed with water in a mixing tank mounted on a boat and then spread over the lake surface. The pH of the epilimnion rose quickly from below 5.0 almost to 7.0 and that of the hypolimnion rose approximately to 6.0. Following fall overturn, the whole-lake pH fell quickly almost to its pre-liming value. Fluctuations of pH 3 km downstream from the lake were equal to those in the lake. The effects of liming on pH had disappeared by the end of February 1982. On a few occasions in the fall and winter following liming, a shallow stratum of exceptionally acid water overlay the mass of limed water in the lake. The usefulness of lakes as reservoirs of neutralized water may be reduced by incomplete mixing of acidic inflows with the lake water and consequent low pH of the outflow. By the end of 1982, approximately 60% of the lime added to the lake had been detected in the water column. The remainder is presumed to have been immobolized on the lake bottom. Concentrations of Al, Mn, Cu, and Zn were significantly lower following liming but that of Fe was higher. Although it is feasible to add lime to headwater lakes to regulate fluctuations in the pH of rivers and to maintain the pH at levels favorable to Atlantic salmon; in Nova Scotia where lakes are small and their rates of flushing are rapid, lime must be added at frequent intervals. (Author's abstract)
W84-03811

TREATMENT OF NEW YORK'S ADIRONDACK LAKES BY LIMING,
W. A. Kretser, and J. R. Colquhoun.
Fisheries, Vol. 9, No. 1, p 36-41, January-February, 1984. 5 Fig, 1 Tab, 17 Ref.

Descriptors: *Lake restoration, *Water quality control, *New York, *Adirondacks, Neutralization, Limestone, Acid lakes, Lime, Policy.

Neutralizing agents have been used in New York to raise the pH of lakes since 1959. Several ponds were treated with hydrated lime to improve the survival of stocked salmonids in the first phase of the program, from 1959 to 1963. The second phase consisted of treatments with various limestone and lime products during the 1970's. The third phase, conducted concurrently with the second phase, involved tests with a variety of neurtalizing agents and application rates. The effects of lake neutralization on aquatic ecosystems are still poorly known. Until more is known about the effects of treatment, the policy of the New York State Department of Environmental Conservation is to conduct only a limited number of treatment projects as needed to protect unique or extremely valuable aquatic resources, prior to implementation of an emissions control program and reduction in acidic deposition. (Baker-IVI)
W84-03813

NEUTRALIZATION OF ACIDIFIED STREAMS IN WEST VIRGINIA,
West Virginia Dept. of Natural Resources, Elkins. Operations Center.
P. E. Zurbuch.
Fisheries, Vol. 9, No. 1, p 42-47, January-February, 1984. 4 Fig, 1 Tab, 7 Ref.

Descriptors: *Water quality control, *Streams, *Acidity, *Neutralization, *West Virginia, Limestone, Acid precipitation, Lime, West Virginia.

Many streams in the north central and western parts of West Virginia have been severely impacted by acid mine drainage (AMD). A number of others, especially in the eastern mountains, are lightly buffered and small amounts of acid, from mining or acid precipitation, cause severe problems for fisheries. Early efforts made in the neutralization of acidic streams in West Virginia concentrated on lightly buffered waters that gained most of their acid content from watershed geologic conditions. Research led to a method of treating acid stream flow with limestone aggregate contained in water powered rotating drums. Recent development has occurred on a second generation drum that is self-feeding from streamside stored aggregate. The new system's efficiency may permit its application in large streams affected by acid precipitation. (Baker-IVI)
W84-03814

ACID MINE DRAINAGE FROM RECLAIMED COAL STRIP MINES 1. MODEL DESCRIPTION,

Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 2A.
W84-03820

ACID MINE DRAINAGE FROM RECLAIMED COAL STRIP MINES 2. SIMULATION RESULTS OF MODEL,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 2A.
W84-03821

STATISTICAL METHOD FOR THE ESTIMATION OF TREND IN SALINITY IN THE RIVER MURRAY,
Australian National Univ., Canberra. Dept. of Statistics.
R. B. Cunningham, and R. Morton.
Australian Journal of Soil Research, Vol. 21, No. 2, p 123-132, 1983. 5 Fig, 2 Tab, 4 Ref.

Descriptors: *Salinity, *River Murray, *Australia, Chlorides, Water quality control, Statistical analysis, Estimating, Low flow.

A simple statistical model is presented for the analysis of salinity measurements. The model is illustrated in detail for chloride concentration determinations in the River Murray at Morgan, South Australia, over a period of 43 years. High salinity in the lower Murray waters poses many present and potential problems for agriculture, domestic and industrial users of the water. Small changes in water quality are often difficult to detect because of large variability in the data, particularly in the lower reaches of the River Murray, where the problem is most acute. Estimates of trend cannot be properly be interpreted unless there is an appropriate statistical model to account for this variability. A positive trend has occurred in the river over and above that associated with a decline in waterflow. Some insight into the form of the trend is provided by a moving average of the log-chloride concentration after allowing for waterflow effects. Despite such extensive data, the linear component of this trend is not precisely established, as is clear from the wide confidence limits. (Baker-IVI)
W84-03876

USING VEGETATION FOR NON-STRUCTURAL SEDIMENT CONTROL,
Land-Tech Consultants, Inc., Ridgefield, CO.
For primary bibliographic entry see Field 6F.
W84-03987

AERATOR-BOAT PROJECT APPLICATION TO THE SAMBRE REAERATION (PROJET DE BATEAU AERATEUR APPLICATION A LA REAERATION DE LA SAMBRE),
J. Dequinze.
Tribune du Cebedeau, Vol. 36, No. 477-478, p 375-380, 1983. 4 Fig.

Descriptors: *Aerator boat, *Wastewater facilities, Sambre River, Water pollution treatment, Water treatment facilities, Aerators, Dissolved oxygen, Prototypes.

A good means of increasing the dissolved oxygen concentration in natural and artificial bodies of water is to use an aerator-boat. The Sambre river is used to demonstrate the flexibility and efficiency of the aerator-boat because the river is heavily polluted. The aeration-boat is equipped with an American aeration apparatus composed of 48 jets immersed approximately 2 to 3 meters. The ejection nozzles have been fitted for use as propulsion devices and for aeration reaction purposes. The actual size of the boat is 26 m in length, 3.6 meters in width and weighs 25 tons. The aeration apparatus is 16.8 m long with the jets set 0.7 meters apart. Protection of the ramp is assured by a lower horizontal deflector which helps to avoid contact with high bottom sediment which might then be resuspended. The aerator-boat is adaptable for use in natural waters (rivers, lakes) and for artificial basins (chemical wastewater lagoons). (Murphy-IVI)
W84-04002

PLANNING MODEL FOR LAND APPLICATION OF SEWAGE SLUDGE,
Cornell Univ., Ithaca, NY.
For primary bibliographic entry see Field 5E.
W84-04045

PHOSPHORUS MANAGEMENT TO PROTECT LAKE WATER QUALITY,
Pennsylvania State Univ., University Park. School of Forest Resources.
L. M. Antosch.
Water Resources Bulletin, Vol. 20, No. 1, p 23-26, February, 1984. 1 Fig, 4 Tab, 12 Ref.

Descriptors: *Water quality management, *Phosphorus, *Gravel pit lakes, *Lakes, *Iowa, *Ames, Water supply, Land use, Drainage, Chlorophyll a, Pollution load.

During the midwestern drought of 1976 and 1977, the City of Ames, Iowa, experienced a water shortage and had to rely of the Hallet Quarry gravel pit lakes as a supplemental source of drinking water. The importance of this water resource was realized from this experience and plans were initiated to try to incorporate it into the municipal water source. A concern about future water quality arose when sand and gravel extraction operations altered the surface drainage pattern. A modified version of the Vollenweider input-output model was used to predict further water quality under various watershed land use, drainage, and lake configurations. The future lake total phosphorus and chlorophyll a concentrations are dependent upon two factors: the lake configuration, and the phosphorus load. A single lake would have about a 20% lower chlorophyll a concentration than the south lake in the two lake group, due to the increased lake volume and surface area and reduced flushing rate. Reducing the phosphorus load would produce a greater reduction in chlorophyll a concentrations than having a larger lake. It is recommended that a management plan to protect the future water quality should be oriented towards reducing the sources of phosphorus to the lakes. (Moore-IVI)
W84-04100

WATERBORNE NUTRIENT BUDGETS FOR THE RIPARIAN ZONE OF AN AGRICULTURAL WATERSHED,
Georgia Univ., Athens. Inst. of Ecology.
For primary bibliographic entry see Field 2H.
W84-04114

WATER-TABLE RISE DUE TO INFILTRATION FROM CANALS,
Ahmadu Bello Univ., Zaria (Nigeria). Dept. of Water Resources and Environmental Engineering.
M. A. Gill.
Journal of Hydrology, Vol. 70, No. 1-4, p 337-352, 1984. 12 Fig, 2 Tab, 6 Ref.

Descriptors: *Infiltration, *Irrigation, *Groundwater contamination, Salinity, Canals, Water table fluctuations, Water pollution sources.

One dimensional analysis of the rise of water table under the influence of infiltration from a canal of constant water level is treated. Results are also presented for more than one canal recharging an aquifer. The case of unsymmetrical (eccentric) location of a canal which is parallel to the boundaries of the aquifer is also treated. It is assumed that the linear equation of mass conservation can adequately predict the phenomenon of rising water table due to infiltration from canals. Predictions from the formulated solutions can be accepted as first approximate estimates which can later be refined using numerical methods for solving the nonlinear equations, if needed. Numerical results are presented graphically. (Baker-IVI)
W84-04160

VARIATION OF LAS AMOUNT IN RIVERS AFTER PROHIBITION OF DETERGENTS CONTAINING PHOSPHORUS,
Shiga Prefectural Inst. of Public Health and Environmental Science, Otsu (Japan).
Y. Tanaka, H. Nakanishi, T. Tsuda, and K. Matsushita.
Japanese Journal of Limnology, Vol., 44, No. 4, p 298-303, October, 1983. 7 Fig, 3 Tab.

Descriptors: *Detergents, *Linear alkylbenzenesulfonate, *Lake Biwa, *Shiga Prefecture, *Japan, Water pollution control, Phosphorus, Sediments, Organic matter.

The Lake Biwa Eutrophication Prevention Ordinance, which prohibits the sale and use of domestic synthetic detergents containing phosphorus, was enforced in Shiga Prefecture in July, 1980. Before and after the enforcement of the ordinance, variations of the amount of linear alkylbenzenesulfonate (LAS) in rivers flowing into Lake Biwa have been investigated with the following results. The amount of C12-LAS remained constant or slightly decreased after the enforcement of the ordinance. For example, at Hyota River, the amount of C12-LAS remained constant but the T-P amount decreased. This means that the inhabitants of the drainage changed their detergents from ones containing phosphorus to phosphorus-free ones. A correlation coefficient of 0.941 exists between C12-LAS and ignition loss of the river sediment. Thus, the remaining LAS seems to have some relation to the organic matter. The relative abundances of C13-LAS and C14-LAS in the total LAS (e.e. C10 through C14-LAS) in the river sediment were higher than those in the river water. (Author's abstract)
W84-04167

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

EFFECTS OF INSTREAM FLOW REQUIREMENTS ON WATER SUPPLY RELIABILITY: THE CEDAR/TOLT SYSTEM AS A CASE STUDY,
Washington Univ., Seattle. Dept. of Civil Engineering.
R. M. Snyder, R. N. Palmer, and D. P. Lettenmaier.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84 169424, Price codes: A07 in paper copy, A01 in microfiche. Water Resources Technical Report No. 83, December, 1983. 135 p, 20 Fig, 6 Tab, 70 Ref, 2 Append. Project No. OWRT A-117-WASH (1), Contract/Grant No. 14-34-0001-2151.

Descriptors: *Instream flow requirements, Reliability, Water supply, *Monte-Carlo simulation, System performance, Model studies, *Washington, Seattle, *Municipal water supply.

The determination of water supply performance, when instream flow requirements for fish are place on a municipal water supply, was studied. A summary of the procedures used to establish instream flow requirements (IFR) is presented in which the procedures are reviewed relative to their major assumptions, data requirements, potential uses, and potential shortcomings. It is concluded that simplified procedures, such as statistical methods, should only be used for cursory investigations and that quasi-habitat models should be used when significant potential impacts exist. To illustrate the impact of water supply system performance of IFR, a case study of the Seattle water supply system is presented. The case study involves the use of a computer simulation model, together with synthetic streamflow sequences, to investigate the indices of system performance. Through a series of Monte Carlo simulations, the tradeoffs between the values of IFR and municipal water supply performance are quantified. It is determined that IFR can decrease the performance of the water supply significantly; for the case study presented by an

order of magnitude. The procedure of developing explicit tradeoffs between values of IFR and the performance of water supplies presented in this study, although no panacea, does present a means of estimating the impacts of IFR on municipal use of water before the requirements are adopted.
W84-03582

EVALUATION OF THE UNCERTAINTY IN PREDICTING HYDROLOGIC INPUTS AND THE EFFECT OF UNCERTAINTY ON WATERSHED MANAGEMENT DECISIONS RELATED TO WATER OR SOIL CONSERVATION MEASURES FOR SMALL WATERSHEDS,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 2A.
W84-03668

ANALYSIS OF CONCEPTUAL DESIGNS FOR REMEDIAL MEASURES AT LIPARI LANDFILL, NEW JERSEY,
GeoTrans, Inc., Reston, VA.
P. F. Andersen, C. R. Faust, and J. W. Mercer.
Ground Water, Vol. 22, No. 2, p 176-190, March-April, 1984. 16 Fig, 6 Tab, 13 Ref.

Descriptors: *Water quality control, *Landfills, *Lipari Landfill, *New Jersey, Cleanup operations, Decision making, Planning, Path of pollutants, Permeability. Mathematical models, Groundwater movement, Drainage, Clay cap.

The Lipari Landfill is a six-acre former gravel pit and industrial chemical dump located in Glouchester county near Pitman, New Jersey. The landfill is constructed in shallow unconsolidated sedimentary material. Of most importance at the landfill is the potential for contaminated groundwater migration in the Cohansey Formation, and subsequent discharge into surface waters. A permeability conceptual design analysis was performed on various remedial measures for the Lipari Landfill, during the two weeks from March 12 through March 26, 1982. The analysis quantified discharge to drains, flow rates to a swamp downstream of the landfill, time required to drain the landfill, and contaminant travel times that would result from the implementation of each of the remedial measures that were suggested for this site. The sensitivity simulations were designed to test a slurry wall, drain location, drain depth and a clay cap. Analytical solutions were designed to analyze water in place, flow through an underlying layer, draining the lower Cohansey, flushing the contaminated area using wells, and convective arrival time of the contaminants to drains. The effect of the slurry wall is to limit flow to the drain. The closer the drain to the landfill, the faster the water level in the landfill will drop. The flow rate for a 30-ft drain converged in time toward a value of 150,000 gpd. The flow rate for a 120-ft drain tended toward 180,000 gpd. The rates for flushing the contaminated zone by injection and pumping wells, as an alternative to draining, will be limited by the maximum head differential between wells. (Baker-IVI)
W84-03762

SPECIFICATION OF OBJECTIVES BY GROUP PROCESSES IN MULTIOBJECTIVE WATER RESOURCES PLANNING,
Department of the Interior, Washington, DC. Office of Water Policy.
J. P. Deason, and K. P. White, Jr.
Water Resources Research, Vol. 20, No. 2, p 189-196, February, 1984. 1 Fig, 1 Tab, 19 Ref.

Descriptors: *Decision making, *Planning, *Irrigation programs, Water resources, Water supply development, Indian reservations.

One weak link in previous attempts to apply multiobjective decision-aiding tools to actual decision problems has been the initial specification of a usable set of objectives. One new aproach to this problem applies findings about group processes to the development of a suitable procedure for generating and structuring ideas. The procedure, in turn, is applied to determine a set of objectives for the selection of a portfolio of water projects. The procedure results in the definition of a set of objectives that is minimal, operational, complete, decomposable, nonredundant, and hierarchically structured. The procedure is demonstrated effectively in the context of an actual problem situation in water resources planning. In order to invest the limited funding available for water projects on Indian reservations as wisely as possible, the development of a decision support system was initiated to assist with water project portfolio selection decisions that are made as part of the annual appropriations cycle. (Baker-IVI)
W84-03816

PERFORMANCE OF LDR MODELS FOR PRELIMINARY DESIGN AND RESERVOIR OPERATION,
Cornell Univ., Ithaca, NY. Dept. of Environmental Engineering.
J. R. Stedinger.
Water Resources Research, Vol. 20, No. 2, p 215-224. February, 1984. 6 Tab, 28 Ref.

Descriptors: *Decision making, *Reservoir operation, *Linear decision rule, Maintenance, Planning, Linear programming, Systems analysis, Model studies.

Linear decision rule (LDR) chance-constrained reservoir models have held promise of developing into simple reservoir screening models and of producing reasonable operating policies. Single and multiple LDR models using two release rule structures are examined in the context of a multiple-purpose reservoir operating problem. The LDR models were of questionable value for screening purposes in this instance. As operating policies, computed LDR policies were less efficient than simple alternatives at meeting water supply and minimum storage targets when subject to constraints on available active or control storage capacity. While mathematical simplicity is an advantage of single LDR screening models over some competitors, simplicity is not justification for its use. (Baker-IVI)
W84-03819

IMPROVING WATER UTILITY MANAGEMENT,
Cincinnati Univ., OH. Dept. of Mechanical and Industrial Engineering.
R. L. Shell, and N. A. Damachi.
Water Engineering and Management, Vol. 131, No. 2, p 42-44, February, 1984. 10 Ref.

Descriptors: *Utilities, *Management, Computers, Pricing, Forecasting, Planning, Water supply, Data processing.

Three major areas of concern exist in the current water utility management industry. One of these in the plethora of federal legislation which has created a tremendous need for data collection and storage. Secondly, there are deteriorating conditions in many older urban water systems, treatment facilities, pumping stations and underground distribution systems resulting in energy waste and creating a potential for public health problems. Thirdly, there is a need to provide for more efficient water delivery as energy, labor, and material costs continue to escalate. These needs are being met through use of computers and systems analysis planning. (Baker-IVI)
W84-04005

GUIDELINES FOR CLOUD SEEDING TO AUGMENT PRECIPITATION.
For primary bibliographic entry see Field 3B.
W84-04041

6B. Evaluation Process

WATER FOR SYNFUELS DEVELOPMENT: PROBLEMS IN ACQUISITION AND DEVELOPMENT,
Varanesh, Raisch, and Schroeder, Boulder, CO.
G. Vranesh, and E. Riordan.
Natural Resources Lawyer, Vol. 16, No. 3, p 439-468, 1983. 162 Ref.

Descriptors: *Synfuels, *Water supply development, *Resources development, *Legal aspects, Energy, Fuels, Colorado River, River basins, Natural resources, Equitable apportionment, Water rights.

Water supply limitations may constrain the development of the abundant energy resources located in the western portion of the United States since the development processes (extraction, transportation, milling), and the population growth generated by such development all demand sizable quantities of year-round water supply. Issues that a synfuels development company should investigate thoroughly in acquiring the necessary rights to satisfy its water requirements are discussed. Water developers must be prepared to take a comprehensive look at the entire Colorado River system to ensure that a firm long-term supply of water is acquired. The water developer cannot limit the analysis to the water-right priority granted pursuant to state water law. Rather, the developer must also examine all other nonstate water-law constraints, including the law of the river, the federal reserved water rights doctrine, the doctrine of equitable apportionment, and federal environmental laws. (Baker-IVI)
W84-03534

PRICING AND CONSERVATION OF IRRIGATION WATER IN TEXAS AND NEW MEXICO,
Texas A and M Univ., College Station. Water Resources Inst.
J. R. Ellis, R. D. Lacewell, G. C. Cornforth, and P. W. Teague.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84 169440, Price codes: A06 in paper copy, A01 in microfiche. Technical Report No. 125, October, 1983. 110 p, 22 Fig, 13 Tab, 55 Ref, 1 Append. Project No. OWRT C-90080-C (0486)(1), Contract/Grant No. 14-34-0001-486.

Descriptors: *Water conservation, *Demand, Irrigation water, *Water pricing, *Cropping patterns, *Community impact, Surface water, Groundwater, El Paso, *Texas, New Mexico, High Plains, Ogallala Aquifer.

Two possible policy alternatives for management of limited water suplies in arid portions of Texas and New Mexico were analyzed for economic feasibility. Detailed studies of the potential impact of a water accumulation policy for each of two irrigtion districts were undertaken using temporal linear programming techniques. Current cropping practices, soils, groundwater conditions, historical surface water allocations for Elephant Butte Reservoir and evaporation rates were incorporated within the analysis. Estimates of the benefits of accumulation of surplus portions of irrigation district member's annual surface water allocations, with subsequent use of the unevaporated portion in later years, were deemed insufficient to cover anticipated administrative costs of implementing the proposed policy. This suggests current allocations approximate a temporal optimum. Additional analysis of possible price-induced water conservation for the areas within the two states currently mining groundwater from the exhaustible Ogallala Aquifer was also undertaken. The High Plains of Texas served as the representative region of study, with results assumed to be analogous for the portions of Eastern New Mexico relying on the Ogallala. Both static and temporal effects of a per unit tax on water pumpage and net returns were examined using a recursive linear programming model. Results indicated that imposition of a $20 per acre-foot tax on water pumped induced very little change in water use over a 40 year period, while reducing the present value of producer net returns from 9% to 27% depending upon initial groundwater conditions and the irrigation technology in use. These results imply that a price-induced water conservation policy for the Ogallala is not economically justified.
W84-03570

WORK PLAN FOR THE SANGAMON RIVER BASIN, ILLINOIS,

Geological Survey, Urbana, IL. Water Resources Div.
J. K. Stamer, and D. M. Mades.
USGS Open-File Report 82-693, 1983. 26 p, 3 Fig, 5 Tab, 22 Ref.

Descriptors: *Suspended sediments, *Pesticide residues, *Oxygen balance, *Flood routing, *Nutrients, *Agricultural runoff, Sangamon River, *Illinois.

The U.S. Geological Survey, in cooperation with the Division of Water Resources of the Illinois Department of Transportation and other State agencies, recognizes the need for basin-type assessments in Illinois. This report describes a plan of study for a water-resource assessment of the Sangamon River basin in central Illinois. The purpose of the study would be to provide information to basin planners and regulators on the quantity, quality, and use of water to guide management decisions regarding basin development. Water quality and quantity problems in the Sangamon River basin are associated primarily with agricultural and urban activities, which have contributed high concentrations of suspended sediment, nitrogen, phosphorus, and organic matter to the streams. The impact has resulted in eutrophic lakes, diminished capacity of lakes to store water, low concentrations of dissolved oxygen, and turbid stream and lake waters. The four elements of the plan of study include: (1) determining suspended sediment and nutrient transport, (2) determining the distribution of selected inorganic and organic residues in streambed sediments, (3) determining the waste-load assimilative capacity of the Sangamon River, and (4) applying a hydraulic model to high streamflows. (USGS)
W84-03604

TUG HILL AQUIFER: A COMMUNITY INVOLVEMENT AND EDUCATION PROGRAM PLAN.
Report, Temporary State Commission on Tug Hill, Watertown, NY., August, 1982. 45 p, 6 Fig, 2 Tab, 1 Ref, 2 Append.

Descriptors: *Aquifers, *Groundwater management, *Regional planning, *Policy making, *Public participation, Economic impact, Groundwater storage, Public policy, Groundwater movement, Industrial water, Groundwater pollution, Water supply.

The Tug Hill Aquifer is a major regional groundwater resource vital to the economy and quality of life in the southern portion of the Tug Hill region in New York. The aquifer has a large storage capacity that stretches from the Salmon River basin in Oswego County into Jefferson County in the north and Oneida County in the southeast. The Temporary State Commission on Tug Hill has prepared a study proposal for a two-year project to gain information and to investigate policy options for the aquifer. This Program Plan will be used by the Salmon Rivers Cooperative Planning Board/Conservation Advisory Council to inform and involve communities and citizens in the Tug Hill Aquifer study area in the assessment of the physical aspects of the aquifer and related resources, in the development of management tools, and in the assessment and development of appropriate groundwater management strategies. Two community involvement and education plans are included in the Program Plan, one assuming full funding, the other assuming partial funding. Both plans contain the same three elements: (1) a community involvement and education program plan that details aquifer education projects and a time schedule for their implementation; (2) a recommended agenda for Planning Board participation in the development of education projects; and (3) a model agenda to Town Board/Planning board discussion. (Fazio-Omniplan)
W84-03659

PORTS AND HARBORS TECHNICAL REPORT.
New England River Basins Commission, Boston, MA.
Volume 3, September, 1981. 198 p, 10 Fig, 19 Tab, 2 Append.

Descriptors: *Port authorities, *Harbors, *Port facilities, *Marinas, *Piers, *Regional planning, *Long-term planning, Docks, Regional development, Economic aspects, Economic growth, Economic impact, Cargoes, Containerization.

The overall effectiveness of New England's port system, and its ability to accommodate varied development pressures within a confined space, are evaluated relative to: regional economy, trade, and port cargo trends and potentials; port institutions; and potential regional trends in harbor development. Reflecting the nonmanufacturing based economy of the region, New England ports have handled declining volumes of cargo throughout the past decade. Petroleum remains the largest volume cargo, with a diversity of other bulk and neo-bulk cargoes being important regional port business. The impact of containerization has centralized and diverted regional flows of general cargo. Prospects for the future indicate stable trade levels, with the possible exception of some growth in container movements through a few New England ports, and the reintroduction of domestic coal receipts in many regional harbors. Capacity utilization varies throughout the region. The highest, 88%, occurs in Bridgeport, while some facilities are rarely used for cargo-handling purposes. Common-user marine terminals account for approximately 13% of all regional port facilities. The container facilities in Boston are the only dedicated, special purpose, common-user terminals in the region. Many of the region's ports are served by narrow finger piers and small backup areas which tend to limit operations to traditional break-bulk cargoes. The institutions that own common-user facilities include private, state and local governments. (Garrison-Omniplan)
W84-03681

OPTIMAL CONTROL PROBLEMS IN TIDAL POWER,
Reading Univ. (England). Dept. of Mathematics.
For primary bibliographic entry see Field 8B.
W84-03726

EVALUATION OF URBAN RIVERSCAPE AESTHETICS IN THE CANADIAN PRAIRIES,
Saskatchewan Univ., Saskatoon. Div. of Hydrology.
J. W. Pomeroy, M. B. Green, and J. E. Fitzgibbon.
Journal of Environmental Management, Vol. 17, No. 3, p 263-276, October, 1983. 3 Fig, 3 Tab, 32 Ref.

Descriptors: *Planning, *Aesthetics, *Canada, *Urban areas, *Rivers, Management planning, Evaluation, Recreation, Vegetation, Land use, Scenery.

Perception of an urban riverscape is measured, using unbiased differentiation of riverscape photographs by 30 University of Saskatchewan students from various backgrounds and disciplines. Multidimensional scaling of the resultant similarity matrix revealed three cognitive constructs (dimensions) used to evaluate the riverscape. Cluster analysis of the matrix developed clusters of photographs which were plotted on the three dimensions. The common attributes of the photographs in the clusters are those significant to landscape evaluation, their effect assessed in the context of the regional landscape. Attributes eliciting strong responses are color, vegetation, soil exposure, land use, blight and cultural features. The methodology developed is not directed towards preferred landscapes, but towards evaluation of landscapes in a specific regional context. (Baker-IVI)
W84-03771

IMPLEMENTING THE PARITY PROMISE: AN EVALUATION OF THE COLUMBIA BASIN FISH AND WILDLIFE PROGRAM,
Lewis and Clark Coll., Portland, OR. Northwestern School of Law.
M. C. Blumm.
Environmental Law, Vol. 14, No. 2, p 277-358, 1984. 334 Ref.

Descriptors: *Legal aspects, *Wildlife management, Fish and Wildlife Program, Columbia River Basin, River basins, Rivers, Columbia River, Environmental impact statement.

The Pacific Northwest Electric Power Planning and Conservation Act promised parity for the Columbia Basin's fish and wildlife in the planing and operation of the Federal Columbia River Power System. The Act established the Northwest Power Planning Council and directed the Council to formulate an unprecidented restoration program to compensate for past and ongoing fish and wildlife losses attributable to the Nation's largest hydroelectric system. The Fish and Wildlife Program is evaluated, assessing its prospects for restoring the once bountiful salmon and steelhead runs of the upper Columbia Basin, and some of the implementation difficulties that have confronted the Program since its approval. The fish and wildlife innovations of the Northwest Power Act include full compensation for fish and wildlife losses, off-site enhancement, ratepayer financing, and changed burdens of proof. The process that Congress established for approving the Program is explained. Specific fish and wildlife measures approved by the Council are evaluated and difficulties encountered in funding some of the measures called for by the Program are reviewed. While the Program represents a pathbreaking commitment to preserve and restore the Columbia Basin's fish and wildlife, it could be improved if the Council adopted certain program amendments and if Congress passed legislation to speed implementation. (Baker-IVI)
W84-03861

DEVELOPMENT OF WELLS IS VITAL,
Water Research Centre, Marlow (England).
L. Clark.
The Johnson Drillers Journal, Vol. 55, No. 3/4, p 12-14, 1983. 1 Fig, 7 Ref.

Descriptors: *Wells, *Water supply development, Evaluation, England, Pump wells, Decision making, Aquifer characteristics, Permeability, Seepage.

Laboratory scale experiments can serve a useful role in evaluating well behavior. Such tests show that hydraulic losses across well screens alone are negligible. Well losses, in the main, take place in the aquifer or in gravel pack adjacent to the well screen. Irrespective of the negligible losses across the screen, well-losses become significant in field situations when the screen open areas fall below about 10%. Aquifer invasion by drilling fluid, including drilling water alone, can seriously reduce the permeability of the aquifer around the well. Such permeability reduction will lead to excessive losses and drawdown in the well if the invasion is not reversed. Well development leading to full recovery of aquifer properties adjacent to the well can be extremely difficult to achieve. (Baker-IVI)
W84-03953

COOPERATIVE SEPARATISM MARKS RALEIGH'S WATER/WASTEWATER OPERATIONS,
Feinschreiber and Associates, Miami, FL.
P. Hersch.
Water Engineering and Management, Vol. 131, No. 2, p 19 and 49, February, 1984. 1 Fig.

Descriptors: *Management, *Utilities, *Water treatment, *Wastewater treatment, *Raleigh, *North Carolina, Computers, Decision making, Planning.

At Raleigh, North Carolina, the management of the Department of Public Utilities has opted to integrate wastewater and water services to the extent of acting cooperatively where possible, yet functioning with defined, independent budgets and sources of revenue. Management of combined water/wastewater facilities faces a special issue; the interaction of the two units. Management philosophy establishes revenue and expense procedures, but time management sets a utility's organization, management style and division of labor. Being well structured with many of the budgetary and utility charges being handled by computer frees management to plan and prepare for the

future. The utility currently has 52 projects under contract with consultants. One completed project is now returning dividends under an unusual land-use program, which brings in $350,000 per year. (Baker-IVI)
W84-04003

MINI AND MICROHYDRO IN GUJARAT,
Gujarat Irrigation Dept., Gandhinagar (India).
J. F. Mistry.
International Water Power and Dam Construction, p 23-24, February, 1984. 1 Fig, 3 Tab.

Descriptors: *Developing countries, *Water resources development, *Hydroelectric plants, *India, *Gujarat, Mahi River, Tapi River, Narmada River, Planning.

Hydro resources of Gujarat are limited as there are only three major rivers: the Tapi, the Narmada and the Mahi, all of which are interstate rivers with the problems of sharing the power potential. Mini and micro developments are subjected to variable stream inflows as well as seasonal variations in the availability of water, such as is to be expected at dam outlets and canal drop sites. Priority must be given to the development of sites where discharge rates are reasonably continuous over fairly long periods, and where harnessable drops are available. Nine mini hydro schemes have been identified in Gujarat, the details of which are tabulated. The total feasible hydropower potential of the state is 1247 MW. (Baker-IVI)
W84-04073

CALCULATING DESIGN DISCHARGES FOR SMALL-SCALE HYDRO STATIONS,
Energoprojekt, Sofia (Bulgaria).
M. Angelov.
International Water Power and Dam Construction, p 25-26, February, 1984. 1 Tab.

Descriptors: *Hydroelectric plants, *Decision making, Planning, Design criteria, Evaluation.

The economic and technical advantages of small scale hydro plants are often misunderstood because the assessment methods used are inappropriate. A different approach is offered which leads to a better appreciation of the value of these small plants. The role of the small stations should not be to cover power deficiencies but to provide optimum electric energy generation and thereby save fuel for thermal stations or reduce imported electric energy. The incompatibility between small-scale hydro plants and the system approach of large-scale hydro stations necessitates a specific criterion for the energy effectiveness of the small stations. Principles of multipurpose optimization are used to set up criterion upon which to base judgements. (Baker-IVI)
W84-04074

DEVELOPING SMALL-SCALE HYDRO IN CZECHOSLOVAKIA,
Office of the Czechoslovak Federal Premier, Prague.
F. Pazout.
International Water Power and Dam Construction, p 37-38, March, 1984. 5 Fig.

Descriptors: *Hydroelectric plants, *Powerplants, *Water resources development, *Czechoslovakia, Planning, Energy, Economic aspects.

A vigorous program is being implemented in Czechoslovakia to encourage the development of small-scale hydropower, including financial incentives and free expert advice. By 1985 construction will have been gradually started on seven small-scale hydro stations totalling 15.96 MW capacity and 71.1 GWh. In the following five year period the government will arrange for construction of 28 mini hydro stations with an aggregate capacity of 62.35 MW and an output of 271.43 MWh. In addition there are also plans for a large number of refurbished and newly built mini hydro plants with a capacity of 60 kW each and household installations under 35 kW each operated by individuals. It is a great advantage that the full electrification of Czechoslovakia facilitates the connection of new powerplants to the grid, and consequently the full exploitation of their capacities, which favorably influences their economic value. (Baker-IVI)
W84-04081

SUPPLEMENTAL IRRIGATION STORAGE RELIABILITY,
Kansas State Univ., Manhattan.
J. M. Steichen, and J. J. Zovne.
Journal of Irrigation and Drainage Engineering, Vol. 110, No. 1, p 35-45, March, 1984. 10 Fig, 2 Tab, 17 Ref. OWRT project B-059-KAN.

Descriptors: *Supplemental irrigation, *Simulation, *Moisture deficiency, *Kansas, *Reliability, Storage ponds, Watersheds, Precipitation, Temperature, Computer models, Irrigation demand.

Small on-farm supplemental irrigation systems are increasingly being used in sub-humid and humid regions to stabilize farm income and to increase farm productivity. A computer simulation model is used to evaluate the risk of having insufficient water for supplemental irrigation. The model simulates the daily operations of a system consisting of a watershed, pond, and irrigation plot. Daily precipitation and temperature data, which drives the hydrologic functions, is readily obtained from National Weather Service archives. At least 25 years of data is used to determine the frequency of failure of the storage pond to deliver water when there is an irrigation demand. Supplemental irrigation simulations were made for five stations in eastern Kansas (Ft. Scott, Independence, Horton, Manhattan, Belleville). Generalized system reliability curves are generated for moisture deficits ranging from 219-582 mm (8.6-22.9 in.). Moisture deficits increase significantly moving from Ft. Scott in southeastern Kansas to Belleville in central Kansas. Supplemental irrigation becomes less viable with increasing moisture deficit, but may be very important to sustain production. The model is useful for designing an individual system or for establishing design guidelines for a region. (Moore-IVI)
W84-04092

TECHNIQUES FOR DETECTING TRENDS IN LAKE WATER QUALITY,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W84-04103

OPERATION OF A TWO-WELL SYSTEM FOR THE CASES OF COMPETITION AND COOPERATION (EXPLOITATION D'UN SYSTEME DE DEUX PUITS EN SITUATION DE COMPETITION ET EN SITUATION DE COORDINATION),
Ecole Nationale Superieure des Mines de Paris, Fontainebleau (France). Centre d'Information Geologique.
P. Hubert.
Journal of Hydrology, Vol. 70, No. 1-4, p 353-367, 1984. 9 Fig, 1 Tab, 8 Ref.

Descriptors: *Water supply development, *Evaluation, *Wells, Management, Economic aspects, Mathematical equations, Competition, Cooperation, Exploitation.

Two different ways of exploiting a two-well system in steady state are studied. In one case, competition, two different economical agents manage one well each. In the other case, coordination, both of the wells are managed by the same economical agent. These problems are special cases of an oligopoly game. The hydrogeologic conditions are assumed to be favorable for groundwater exploitation in each case and the only limiting factor is economic origin. An equilibrium is always reached in both cases, but in the case of coordinated exploitation, at least one of the wells is operated at a lower production rate than in the case of competitive exploitation. A numerical application is made on a simplified example. (Baker-IVI)
W84-04161

HYDRO PLANT UPGRADED FOR HIGHER OUTPUT AND REMOTE OPERATION,
Burns and McDonnell, Kansas City, MO.
D. Lord.
Power Engineering, Vol. 88, No. 3, p 55-56, March, 1984. 1 Fig, 2 Tab, 1 Ref.

Descriptors: *Powerplants, *Water resources development, Turbines, Computers, Generators, Gantt Dam, Covington County, Alabama.

A statewide survey conducted by the Alabama Electric Cooperative identified an old hydroelectric facility on the Gantt Dam and Reservoir as a potential candidate for rehabilitation and upgrading. Through computer modeling of the site, it was determined that the installation of new equipment would provide a more efficient use of available energy resources. Units 1 and 2 were replaced with a single new unit and unit 3 was upgraded. The new unit consists of a vertical fully-adjustable propeller turbine with a wicket gate assembly. When operational, the generation of the system will increase from 8,200,000 kWh per year to an excess of 9,800,000 kWh per year. (Baker-IVI)
W84-04179

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

IMPROVING WATER UTILITY COST CONTROL,
Consultants to Management, Inc., Providence, RI.
W. T. Gardner, Jr.
Journal of the New England Water Works Association, Vol. 97, No. 4, p 334-342, December, 1983.

Descriptors: *Budgeting, *Utilities, *Costs, *Water distribution, Economic aspects, Cost analysis, Management.

Planning, budgeting, monitoring and reporting of all financial segments of an organization to maximize the assets used in the operations at the lowest possible cost and greatest efficiency is the operating definition given for cost control. The key factor to internal cost control is a budget. External cost control involves vendor price increases, availability of parts, weather, street cave-ins, banking relationships, and other areas where control is limited. More control can be exercised internally and specific areas to be considered include billings, accounts receivable, inventory, purchasing, labor costs and materials costs. (Baker-IVI)
W84-03793

INSTRUMENTAL PRICE ESTIMATES AND RESIDENTIAL WATER DEMAND,
Denver Univ., CO. Dept. of Economics.
C. V. Jones, and J. R. Morris.
Water Resources Research, Vol. 20, No. 2, p 197-202, February, 1984. 1 Fig, 4 Tab, 22 Ref.

Descriptors: *Pricing, *Water demand, Residential, Mathematical models, Water rates, Water use, Denver, Colorado.

When a commodity is sold at a schedule of rates depending on the quantity consumed, econometric analysis must consider questions not encountered for goods offered at uniform prices. Instrumental estimates of two price specifications, one motivated by the consumer decision problem given full information about rates and charges and the other an average price formulation, are developed to correct for measurement error when residential water sales are made at a schedule of rates, rather than at uniform prices. Annual water purchases of single-family residences are regressed on these instrumental price estimates, family income, and household size by ordinary least squares, based on a sample of 326 observations from metropolitan Denver, Colorado, for 1976. The resulting demand estimates are robust to the price concept specified, given proportional variation in all rates and charges, and are consistent with findings in the literature. The overall price elasticity estimates range between -0.14 in a linear model to -0.44 in a

log-log model, while the estimated income elasticity varies between 0.40 and 0.55. (Murphy-IVI)
W84-03817

6D. Water Demand

GROUND-WATER RESOURCES AND GEOLOGY OF DODGE COUNTY, WISCONSIN,
Geological Survey, Madison, WI. Water Resources Div.
For primary bibliographic entry see Field 2F.
W84-03651

GROUND-WATER RESOURCES, CUMBERLAND COUNTY, NEW JERSEY,
Geological Survey, Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 2F.
W84-03682

GEOLOGY AND WATER RESOURCES OF THE WHARTON TRACT AND OF THE MULLICA RIVER BASIN IN SOUTHERN NEW JERSEY,
Geological Survey, Trenton, NJ. Water Resources Div.
E. C. Rhodehamel.
Special Report No. 34, New Jersey Dept. of Environmental Protection, 1973. 58 p, 15 Fig, 9 Tab, 65 Ref.

Descriptors: *Aquifer characteristics, *Potential water supply, *River basins, *Surface-groundwater relations, Dissolved solids, Acidic water, Long-term planning, Rivers, Basins, Gaging stations, Gaging streams, Water quantity.

Unlike many land acquisitions for water-supply purposes, the Wharton Tract in southern New Jersey was purchased by the state prior to area needs. Population and industrial trends and estimates of the water-supply reserves within present service areas for Camden and Atlantic City suggest that near-maximum utilization of the tract's water-supply potential may not be needed before 2000 A.D. Principal aquifers are in the Kirkwood Formation, Cohansey Sand and in overlying hydraulically connected deposits of Quaternary age. Ground water and surface water in the Mullica River basin are low in dissolved solids, generally less than 50 mg/l. Iron concentrations are generally high, up to 49,000 micrograms per liter in ground-water and up to 7,100 micrograms per liter in the streams. The water is acidic, as indicated by typical pH values of from 4.5 to 6.5. Color of the surface water is commonly high, ranging from 3 - 150 platinum-cobalt units. After appropriate treatment these waters are acceptable for most uses. Mean discharge from the 180.6-square mile area is 202 mgd, or 1.12 mgd per sq. mile. The Wharton Tract is well situated to support the growing water needs of nearby communities. Maximum water development can be achieved by conjunctive use of ground and surface water. It is estimated that 70 mgd of water could be developed with minimal effect upon low flows in the half of the tract above the gaging stations on the Mullica and Batsto Rivers. (Garrison-Omniplan)
W84-03686

APPRAISAL OF WATER RESOURCES IN THE UPPER VERDE RIVER AREA, YAVAPAI AND COCONINO COUNTIES, ARIZONA,
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 2F.
W84-03689

ESTIMATED IRRIGATION WATER USE IN FLORIDA, 1980,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-03696

COMPARISON BETWEEN THE PROBABILITY AND SIMULATION PROCEDURES FOR STORAGE ANALYSIS,
Monash Univ., Clayton (Australia).
R. M. Phatarfod.
Journal of Hydrology, Vol. 69, p 29-41, 1984. 6 Tab, 20 Ref.

Descriptors: *Comparison studies, *Probabilistic process, *Simulation analysis, *Water storage, Water supply, Water demand, Water requirements, Mathematical models, Markov flows, Dams, Yarra River, Victoria, Australia.

During the past 25 years or so, two classes of methods have been introduced to study the relationship between reservoir size, demand of water and reliability of supply. Two simulation procedures and three probability procedures for determining the size of a reservoir required to meet a certain demand of water are compared. A case-study of the river Yarra, in Victoria, Australia, is given and the probability of emptiness of the dam obtained by using all the five methods. The input model considered is that of seasonally dependent first-order Markov flows. The probability procedures applicable for such an inflow model are the (numerical) probability matrix procedure and two analytical procedures which assume the dam to be bottomless. All the probability procedures involve discretization of the problem, and for reasonable accuracy, the unit of measurement need not be small. This means that the matrices involved need not be large and the computational problem is quite manageable. The analytical procedures, while not being quite appealing to the engineer, have the advantage that through their use it would be possible to derive algorithms for working out dam sizes, which make use of only the annual flow parameters and the seasonal transitional probabilities. (Murphy-IVI)
W84-03775

COMPETITION FOR WATER,
J. P. Smith.
The Johnson Drillers Journal, Vol. 55, No. 3 & 4, p 8-11, 1983. 2 Fig.

Descriptors: *Water use, *Water resources development, *Water management, Water quality, Water supply development, Public health, Energy, Conservation, Recycling.

Nearly 150 of the world's major river basins are claimed or shared by two or more countries. Nearly half the people in the world live in the Third World nations without adequate sanitation facilities. Nearly 80% of all disease and sicknesses such as malaria, schistosomiasis and typhoid are the result of substandard water or sanitation. Two major conflicts surrounding water development dominate water politics in the American West: plans to divert water from northern to southern California, and the competition between coal developers and other interest groups in the northern Great Plains. Conservation is a critical water management tool, and a potential 'new' water source. Two areas where there may be opportunities for substantial water savings are more efficient irrigation techniques and large-scale wastewater recycling. (Baker-IVI)
W84-03952

6E. Water Law and Institutions

PROTECTION UNLIMITED: A PREFERRED USER'S RIGHT TO MEANS OF GROUNDWATER DIVERSION IN NEBRASKA,
S. S. Gealy.
Nebraska Law Review, Vol. 62, No. 2, p 270-315, 1983. 266 Ref.

Descriptors: *Well interference, *Groundwater diversion, *Preferred users, *Nebraska, Legal aspects, Water rights, Reasonable use, Ownership of water, Prior appropriation.

Well interference takes place when the cones of depression of two or more wells overlap. The current state of the law in Nebraska is considered as it relates to rights and liabilities in well interference disputes. Certain suggestions are set forth whereby the current law may become more effective. Applicable legal doctrines considered include the English Rule of Absolute Ownership, the American Rule of Reasonable Use, the Restatement Position, and the Doctrine of Prior Appropriation. When the legislative channels for dispute avoidance do not prove sufficient and well interference cases come before the Nebraska Supreme Court, it must decide the controversies through expanding the common law rules to include a balancing of the interests involved in each case. (Baker-IVI)
W84-03535

WATER POLLUTION LAWS: CAN THEY BE CLEANED UP,
Haight, Gardner, Poor and Havens, Washington, DC.
S. A. Wallace, and T. L. Ratcliffe.
Tulane Law Review, Vol. 57, No. 5, p 1343-1367, June, 1983. 157 Ref.

Descriptors: *Water pollution control, *Cleanup operations, *Liability, *Compensation, *Oil spills, Costs, State jurisdiction, International law.

Existing laws of the United States are surveyed as they pertain to oil pollution liability and compensation, and payment for cleanup costs, including the Federal Water Pollution Control Act, Shipowner's Limitation of Liability Act, Trans-Alaska Pipeline Authorization Act, Deepwater Port Act, and Continental Shelf Lands Act. Efforts underway both domestically and internationally that are intended to increase uniformity in the law pertaining to these aspects of oil pollution are considered. The system of liability and compensation for oil spills as it exists in the United States today is ineffective, inefficient, and inequitable. Federal law displays excellent features in spots, but lacks comprehensiveness and uniformity. Each of the several states seeks its own solution. The victim of pollution and the public suffer. Adoption of a comprehensive federal scheme with a domestic fund wrapped around the international Conventions will serve many ends, all constructive. (Baker-IVI)
W84-03546

REPORT OF THE RIVER MASTER OF THE DELAWARE RIVER FOR THE PERIOD DECEMBER 1, 1981 - NOVEMBER 30, 1982,
Geological Survey, Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 4A.
W84-03578

HISTORICAL/CULTURAL FACTORS AFFECTING SOUTH CAROLINA WATER LAWS AND POLICIES AND THEIR RELATIONSHIPS TO PRESENT LAWS AND POLICIES,
Clemson Univ., SC. Dept. of History.
F. Steirer, Jr.
Available from the National Technical Information Service as PB84-154418, Price codes: A08 in paper copy, A01 in microfiche. Water Resources Research Institute, Publication No. 114, September, 1983. 156 p, 283 Ref. Project No. OWRT A-048-SC (1), Contract/Grant No. 14-34-0001-9043, 14-34-0001-1143, 14-34-0001-0143, 14-34-0001-2143.

Descriptors: *South Carolina, *History, *Water law, *Riparian rights, *Water policy, *Policy making, *Political aspects, Administrative decisions, Common law, Drainage, Evolution, Ground water, Legislation, Marshes, Mill dams, Property rights, Reclamation, Social costs, Social values, Water rights, Urbanization, Water allocation, Water use, Dams.

The purpose of this study is to examine the historical development of water law and policy in South Carolina in order to determine why the present water quantity situation exists. During the first period of South Carolina history until 1825, a rudimentary form of prior appropriations functioned with the legislature doing the allocating. From 1825 to 1840, riparian doctrine grew out of

the failure to establish a system of internal improvements and the growing commitment to individual values which in water law were enscribed in riparianism. The period 1840 to 1955 saw a refining of what essentially was a static doctrine, kept in a stagnant condition by the presence of deep-seated 'truths' that operated in South Carolina. After 1953, what has happened is the gradual demise of riparianism because of interbasin transfers. In the 1980's, South Carolina does not appear to be prepared to accept legal doctrine that seem to challenge the legality of long-held riparian rights. Instead, the historical record seems to suggest that small, carefully designed revisions incorporating the recommendations of a recent Water Law Review Committee will be more successful. The 'truths' that helped keep water law from evolving earlier have probably lost some of their influence, although a variety of attitudes, both positive and negative, have been and continue to be present in South Carolina affecting water law and policy.
W84-03665

SUMMARY OF NEW YORK WATER LAW,
Cornell Univ., Ithaca, NY. Law School.
J. B. Bugliari, and L. Cappalli.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84 154368, Price codes: A03 for paper copy, A01 for microfiche. Center for Environmental Research Completion Report, February, 1984. Project No. OWRT A-009-NY (1), Contract/Grant No. 14-34-0001-2134.

Descriptors: *Water law, *New York, Private water rights, Underground water rights, Surface water rights, *State regulation, *Water rights, *Land tenure, *Property rights, *Riparian rights.

A summary is presented of the law affecting private water rights in the state of New York: 'Part I. The Rights of the Landowner' deals with the ways in which private landowners may use the waters on or flowing through their property and the lands adjacent to these waters. Part I breaks down the law affecting water according to the nature of the water involved, that is, water flowing in a defined channel (watercourse) and water not flowing in a defined channel (surface water and percolating groundwater). 'Part II. State Regulation of Landowner's Rights' briefly examines statutory limitations that the state has imposed on landowners to restrict the way in which they may use their waters or lands. Private landowners are not the absolute owner of their property. All property rights arise from the state and may be restricted or taken by the state. Because the state has a strong interest in preserving and promoting its water resources, it often acts so as to affect the traditional rights of landowners to use their lands and the waters on or adjacent to them.
W84-03692

FEDERAL PLAN FOR MITIGATION OF ACID PRECIPITATION EFFECTS IN THE UNITED STATES: OPPORTUNITIES FOR BASIC AND APPLIED RESEARCH,
R. K. Schreiber, and P. J. Rago.
Fisheries, Vol. 9, No. 1, p 31-36, January-February, 1984. 1 Tab, 36 Ref.

Descriptors: *Planning, *Mitigation, *Acid rain, *United States, Environmental effects, Rehabilitation, Acidic water, Water pollution treatment, Fisheries.

The Acid Precipitation Act of 1980 authorized formation of a government-wide interagency task force to develop a National Acid Precipitation Assessment Plan (NAPAP). One of the objectives of NAPAP is the development of mitigation measures for aquatic ecosystems. Given the potential magnitude of the problem and the complexity of its solution, mitigation methods play an important role in protection of fish populations at risk and in rehabilitation of acidified systems to restore fishery productivity. The term 'mitigation' usually connotes application of lime or other base materials to affected surface waters. Mitigation, however, encompasses a much broader range of treatments, including creation of favorable micro-habitats for selected life stages, application of other acid-neutralizing and ligand materials, development of resistant fish strains, and stimulation of biologically-produced alkalinity. Development of mitigation methods should be viewed not only as a response to a pressing national need, but also as a unique opportunity for basic and applied research extending to many areas of fishery science. An active research program on mitigation methods and strategies can provide much insight into the structure and functioning of aquatic system undergoing acidification. (Author's abstract)
W84-03812

POLLUTED GROUNDWATER CLEARLY A PROBLEM, BUT FEW AGREE ON EXTENT OR SOLUTION,
For primary bibliographic entry see Field 5C.
W84-03869

RHODE ISLAND IMPOSES STRICT LIABILITY FOR CONTAMINATION OF WATER BY PERCOLATION OF POLLUTANTS FROM ILLEGAL DUMP SITE,
E. L. Hand.
Natural Resources Journal, Vol. 23, No. 3, p 697-703, July, 1983. 24 Ref.

Descriptors: *Water pollution sources, *Percolation, *Dumps, *Rhode Island, *Liability, Organic compounds, Legal aspects, Industrial wastes.

In general, negligence need not be proved in a nuisance case because the original nature of the defendant's conduct becomes unimportant if the defendant, once notified of the nuisance, fails to eliminate the problem. The Rhode Island Supreme Court ruling, in a case against the operators of an illegal chemical dump, abolished the negligence requirement for a nuisance involving percolating waters. The court was aware of the great need for strict water pollution standards and would not tolerate as serious a nuisance as this situation was. However, in general the courts are not yet willing to impose strict liability of water pollution because of potential cases in which the adverse economic consequences to the community exceed the actual injuries to specific residents. (Baker-IVI)
W84-03967

ECONOMICS AND THE DETERMINATION OF INDIAN RESERVED WATER RIGHTS,
D. S. Brookshire, J. L. Merrill, and G. L. Watts.
Natural Resources Journal, Vol. 23, No. 4, p 749-765, October, 1983. 62 Ref.

Descriptors: *Water rights, *Economic aspects, *Indian reservations, *Reserved rights, Planning, Decision making. Water supply development, Irrigation.

The role of economics in the determination of Indian reserved water rights is discussed. In addition to discussing why economics is important to Indian reserved water rights, some parameters of an appropriate economic analysis which form a perspective differing with other recent papers on the subject are examined. Some specific economic issues in the reserved rights inquiry are considered. Despite its shortcomings, the concept of practicably irrigable acreage (PIA) probably will continue as a yardstick for Indian reserved water rights in western water planning. Strict and appropriate criteria should be used to quantify the PIA. While ethics is undoubtedly important in the question, such considerations should be applied as a whole by the Court, not individually by each discipline within the PIA inquiry. (Baker-IVI)
W84-03968

WATER LAW - SPORHASE V. NEBRASKA,
M. A. Green.
Natural Resources Journal, Vol. 23, No. 4, p 923-931, October, 1983. 43 Ref.

Descriptors: *Water rights, *Legal aspects, *Nebraska, Water supply, Water shortage, Ogallala Aquifer, Arid regions, Groundwater.

The U.S. Supreme Court's decision in the Sporhase vs Nebraska case holds that a Nebraska statute prohibiting the export of groundwater to a state not granting reciprocal rights to transport water into Nebraska violates the Commerce Clause of the Constitution. The finding that water is an article of commerce has a far-reaching effect on water regulation in the arid western states for two reasons. First, the decision glosses over the public-versus-private ownership distinction of groundwater. Second, while absolute bans on water export have been made virtually impossible, the Court acknowledged as legitimate the conservation component of the statute, even though the conservation requirements applied only to out of state users. After this decision, broad or all-encompassing bans on water export will be nearly impossible to sustain. However, the general framework for the regulation of water supplies in the western states is still intact. (Baker-IVI)
W84-03969

GREAT DRAIN ROBBERY,
For primary bibliographic entry see Field 5B.
W84-03971

ORGANIC CONTAMINANTS IN THE AQUATIC ENVIRONMENT; III. PUBLIC HEALTH ASPECTS, QUALITY STANDARDS AND LEGISLATION,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5C.
W84-03995

GUIDELINES FOR CANADIAN RECREATIONAL WATER QUALITY,
R. S. Tobin, and W. M. Ward.
Canadian Journal of Public Health, Vol. 75, No. 1, p 15-18, January/February, 1984.

Descriptors: *Water Quality, *Standards, *Recreation, Epidemiology, Pathogens, Microbiological studies, Chemical properties, Canada.

It is important to establish criteria to assess the relative risk of man-made environmental hazards on persons who bathe, play and swim in our lakes, rivers or oceans. Health hazards associated with direct recreational contact with water include infestations transmitted by pathogenic microorganisms and other organisms and injuries due to impaired visibility in turbid waters. These guidelines deal mainly with health hazards related to recreational water use but they also relate to esthetics and nuisance conditions. A Sanitary Survey of the watershed should identify, in a case-by-case manner, all potential sources of contamination that could impinge on the bathing area. Keeping an accurate epidemiological record of a recreational area, by collecting any known water-borne infections may indicate when the quality of the water is impaired. The recommended fecal coliform concentrations should not exceed 200/100 mL in a recreationally-used area. The pH of the waters used for total body contact recreation should be in the pH range of 6.5 to 8.5. Standardized methods for microbiological sampling and analysis creates valid results. Alternative procedures are also reliable but consistency is of particular importance. (Murphy-IVI)
W84-04008

CANADA'S LEADING ROLE IN IMPLEMENTING THE UNITED NATIONS PROGRAM ON WATER QUALITY MONITORING,
Canada Centre for Inland Waters, Burlington (Ontario).
S. Barabas.
Canadian Journal of Public Health, Vol. 75, No. 1, p 69-73, January/February, 1984. 2 Tab.

Descriptors: *Water quality, *United Nations, *Canada, Global water quality monitoring, Monitoring, Lakes, Aquifers, GEMS/WATER program.

Since 1977, Canada has played a leading role in developing and implementing the United Nations program for global water quality monitoring, Global Environmental Monitoring System for Water (GEMS/WATER). Close to 200,000 water quality data points have been reported to the Global Data Center in Canada by some 350 monitoring stations located on major rivers, lakes and aquifers in 50 countries. The prerequisite was the development and publication of a comprehensive 'operational guide' covering acceptable methods for selecting water sampling sites; sampling; analysis; hydrological measurements; analytical quality control; and data storage and retrieval. Moreover, training courses in the application of such methods had to be given in all parts of the world. This article deals with the origins, significance and implementation of the GEMS/WATER program. (Author's abstract)
W84-04013

CANADIAN PARTICIPATION IN THE INTERNATIONAL DRINKING WATER SUPPLY AND SANITATION DECADE,
Walker and Partners Ltd., Ottawa (Ontari).
B. Grover.
Canadian Journal of Public Health, Vol. 75, No. 1, p 74-78, January/February, 1984. 1 Fig, 3 Tab, 9 Ref.

Descriptors: *Canada, *Water supply development, Water supply, Sanitation, International commissions, International agreements, International Hydrological Decade.

Canada has been an active promoter of the International Drinking Water Supply and Sanitation Decade, whose goal is to provide these basic services to all people in the period 1981-1990. This implies providing improved services to roughly 2,000 million people in the developing countries in ten years, a noble but unattainable goal. However, the Decade could provide a major stimulus to accelerate the provision of services to meet the basic needs of millions of people. Improving public health conditions is the underlying rationale for the Decade. Most of Canada's 25 million people are reasonably well provided with water supply and sanitation. These services are generally provided at the local level by an industry which is highly decentralized and loosely organized. This industry, with an estimated 40,000 employees across the country, has hardly focussed on the opportunities for utilizing Canadian experience and resources to support sector programs in the developing countries. The Canadian International Development Agency continues to provide assistance on a modest scale for a number of activities related to water supply and sanitation projects. Despite nominal support for the Decade, however, there is no evidence that Canada's official development assistance for water and sanitation programs has changed as a consequence of the International Decade. (Author's abstract)
W84-04014

6F. Nonstructural Alternatives

UNIFIED NATIONAL PROGRAM FOR FLOOD PLAIN MANAGEMENT.
Water Resources Council, Washington, DC.
Available from Supt. of Documents, GPO, Washington, D.C. 20402, as S/N 052-045-00058-4. Report to the President and Congress, September, 1979. 89 p, 2 Append.

Descriptors: *Flood plain management, Flood control, Flood protection, Nonstructural alternatives, Water policy, Decisionmaking, Alternative planning, *Flood loss mitigation, *Flood plains preservation, *Flood plain restoration.

This report seeks wise decisions and management for the Nation's floodplains to reduce losses of life and property from flooding and losses of natural and beneficial floodplain values from unwise land use. A conceptual framework is set forth to provide general guidance for the decisionmaking processes of Federal, State, and local officials as well as for private parties. This conceptual framework contains general and working principles that relate riverine, coastal, and other floodplains to the total natural and social systems of which they are a part. It also describes the potential for flood losses and environmental harm associated with the use of floodplains. Each level of government has legal program responsibilities within this framework. The strategies and tools for flood loss mitigation and for the preservation and restoration of natural floodplain values are presented in detail. The means and tools for reducing loss of natural floodplain values are presented in detail. The means and tools for reducing loss of natural floodplain values support four major strategies: (1) avoiding actions that affect adversely the floodplain, whenever there is a practicable alternative; (2) minimizing the adverse impacts of actions that affect the floodplain; (3) restoring previously degraded floodplains to serve their natural functions; and (4) preserving those floodplains whose natural functions are relatively undisturbed. Actions are recommended to facilitate the coordination of management programs dispersed among all levels of governments.
W84-03664

DEVELOPMENT OF A POLICY FOR LEAKAGE CONTROL,
WRC Engineering, Swindon (England).
D. B. Field.
Journal of the New England Water Works Association, Vol. 97, No. 4, p 310-333, December, 1983. 2 Fig, 11 Tab.

Descriptors: *Leakage, *Policy making, Water loss, Pipelines, Reservoirs, Water distribution, Water conveyance, Costs.

Over 500 field experiments or measurements designed to investigate leakage and the various methods of controlling it were carried out in the U.K. Leakage from service reservoirs, trunk mains and distribution systems was measured and the effects of age, diameter and method of construction determined. Also the costs, capital and operating, associated with each method of leakage control were determined together with measurements of the effectiveness of each method at reducing leakage. Data relating to the effects of pressure on leakage, variations in leakage with time and costs of repair were also collected. There was no one method of leakage control appropriate to all distribution systems. A procedure for determining the most appropriate leakgage control policy for any given distribution system has been developed and implemented. Using this procedure it was determined that regular sounding or one-time sounding surveys were economical in only 2% of the systems in the United Kingdom. All others warranted a more intensive method of leakage control. Reduction of distribution pressures by even a small amount can have a significant reduction of leakage levels. Use of the Leak Noise Correlator in conjunction with any method of leakage control will significantly improve the overall efficiency of the operation. (Baker-IVI)
W84-03792

USING VEGETATION FOR NON-STRUCTURAL SEDIMENT CONTROL,
Land-Tech Consultants, Inc., Ridgefield, CO.
R. J. Jontos, Jr., and C. P. Allan.
Public Works, Vol. 115, No. 3, p 88-89, March, 1984. 1 Fig, 1 Tab.

Descriptors: *Sediment control, *Nonstructural alternatives, *Vegetation, *Roads, Drainage basins, Salt, Sand, Cattails.

Approximately 500 cattail tubers were planted on 6 to 12 inch centers in the bottom of a discharge channel which directs water from a road to a small pond. A chicken wire fence covering was placed over the tubers and staked in place. A basin area about 9 x 9 x 2 ft deep was shaped and lined with large flat stones directly below the road discharge culvert outlet and up gradient of the planted discharge channel to act as a velocity dissipator and primary sediment trap. About 0.4 mile of state highway drains to the control area. Based on 25 storms per season, about 7.8 cubic yards of sand are applied to the area from the state highway. Results of the study show that plants can provide satisfactory sediment control. Projected maintenance costs for catch basin cleaning, including a rented vacuum truck and two men, approximates $55 per catch basin per year. (Baker-IVI)
W84-03987

HYDROLOGIC ENGINEERING CENTER EXPERIENCE IN NONSTRUCTURAL PLANNING,
Hydrologic Engineering Center, Davis, CA.
W. K. Johnson, and D. W. Davis.
Water Resources Bulletin, Vol. 20, No. 1, p 15-21, February, 1984. 2 Fig, 15 Ref.

Descriptors: *Nonstructural alternatives, *Flood plain management, Flood control, Planning, Flood damage.

The Hydrologic Engineering Center, Corps of Engineers, has been engaged in research, training, and project assistance in nonstructural flood control planning for Corps offices across the United States since 1975. Lessons learned from this experience deal with the role of nonstructural measures in flood plain management, the role of creativity in analysis, the role of analysis, and tools for analysis. The role of nonstructural measures in flood control planning depends upon the scale of the problem, the nature of the measure, the degree of protection desired, and whether damage is to existing or future property. An earnest seeking for nonstructural opportunities, a field presence for their formulation, and compatability with local infrastructure plans are prerequisite to creative use of nonstructural measures. Analysis is a necessary complement of creativity. Several tools for nonstructural analysis have been developed and applied to flood problems involving several hundred and several thousand structures. (Author's abstract)
W84-04099

OPERATION OF A TWO-WELL SYSTEM FOR THE CASES OF COMPETITION AND COOPERATION (EXPLOITATION D'UN SYSTEME DE DEUX PUITS EN SITUATION DE COMPETITION ET EN SITUATION DE COORDINATION),
Ecole Nationale Superieure des Mines de Paris, Fontainebleau (France). Centre d'Information Geologique.
For primary bibliographic entry see Field 6B.
W84-04161

6G. Ecologic Impact Of Water Development

HYDROLOGIC-INFORMATION NEEDS FOR OIL-SHALE DEVELOPMENT, NORTHWESTERN COLORADO.
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7A.
W84-03608

SALMON RIVERS COOPERATIVE CONSERVATION ADVISORY COUNCIL STREAM STUDY,
State Univ. of New York Coll. at Oswego.
G. Haggerty.
Report, Temporary State Commission on Tug Hill, Watertown, N.Y., December, 1977. 73 p, 14 Fig, 16 Tab, 18 Ref, 3 Append.

Descriptors: *Streams, *Stream classification, *Regional planning, *Chemical analysis, *Water quality, Stream discharge, Water temperature, Dissolved oxygen, Biochemical oxygen demand, Carbon dioxide, Suspended solids, Specific conductivity, Nitrogen, Nitrates, Ammonia, Phosphorus, Alkalinity, Acid streams, Acidity, Coliforms, Macroinvertebrates, Land use, Acid rain, Stream pollution.

It was the goal of this study to collect information pertaining to the water quality and physical characteristics of streams in the Salmon Rivers Cooper-

ative planning area in order to provide: (1) base data that would be helpful to ongoing land use planning efforts; (2) a beneficial educational experience for residents; (3) data that could be used by other agencies interested in the stream and stream water characteristics of the Salmon River Planning area. The overall water quality was excellent. Although some affects of population centers on stream quality were evident, they did not seem to indicate critical problems, but did show some potential problems to be monitored. Samples were obtained from 13 streams in the towns. Parameters measured included stream flow, temperature, dissolved oxygen, biochemical oxygen demand, carbon dioxide, pH, alkalinity, phosphorus, ammonia, nitrogen-nitrate, suspended solids, specific conductance, and total coliform bacteria. Macroinvertebrate samples from the same locations were obtained. Some of the streams should be considered for reclassification. Population centers could have some affect on the streams and should be tested. Monitoring is recommended for (1) the effect of the salmonid hatchery at Altmer on stream quality and (2) the effect of land use on stream quality above the hatchery. Low alkalinity of the streams may increase the effect of acid rains and should be monitored. (Fazio-Omniplan)
W84-03653

HYDROLOGY REPORT FOR THE SALMON RIVERS COOPERATIVE PLANNING BOARD AREA,
New York State Temporary Commission on Tug Hill, Watertown.
For primary bibliographic entry see Field 2A.
W84-03657

TUG HILL REGION: PREPARING FOR THE FUTURE.
Report, Temporary State Commission on Tug Hill, NY., February, 1976. 60 p, 3 Fig, 103 Ref, 2 Append.

Descriptors: *Land use, *Regional planning, *Economic development, *Watershed management, *Forest management, *Water quality management, Urbanization, Acid rain, Acidity, Agriculture, Forests, Recreation, Wildlife, Stream classification, Streams, Water quality standards, Wetlands, Fish, Wind, Flood control, Standards, Regulations, River regulations.

The Temporary State Commission on Tug Hill was formed by the New York State Legislature at the request of local citizens who became concerned when an out-of-state developer obtained an option to buy a very large plot of Tug Hill property. The Commission was charged with studying all factors affecting quality of life and with making recommendations on the future. The Commission found that the social and physical environment of Tug Hill is coming under increasing pressure. Acid precipitation appears to be threatening forest resources, agricultural land, and the region's fishery. The economy is fragile. The most signficant factor that portends an unwanted future for Tug Hill residents is growing urban pressure on the land itself. Left unchecked, land use pressures will lead to speculation, subdivision of parcels, and development for recreational and suburban use. The Commission predicts that over the next 20 years, in the absence of corrective measures, most Tug Hill core lands will be owned by non-residents. The report presents 56 recommendations in eight categories: keep Tug Hill the way it is; maintain a healthy economy; maintain the present high quality of Tug Hill air; protect its watershed and unique areas for enjoyment and utilization; maintain agriculture as a way of life and as a mainstay of the economy; maintain the forests for timber, wildlife, and recreation; maintain Tug Hill's recreational values while providing economic benefits for current residents; preserve home rule and curb the growing cost of government. (Fazio-Omniplan)
W84-03660

SURFACE WATER QUALITY MANAGEMENT PLANNING,
Disko (M.) Associates, Union, NJ.
M. Disko.
Report, July, 1978. 385 p, 39 Fig, 62 Tab.

Descriptors: *Surface water, *Surface-groundwater relations, *Population growth, *Stream discharge, *Streamflow, Streamflow forecasting, Streams, Wastewater disposal, Solid wastes, Catchment areas, Stream profiles, Groundwater quality.

Overall, Ocean County, New Jersey has good to excellent water quality. Some problem areas do exist, however, which are generally related to specific types of land development and use. Clean-up of these few waterways can be successful, but will require the development of appropriate land use practices in the context of an overall water quality management plan. Among the items covered are streamflow measurement and gaging, an inventory of cooling water and wastewater discharge and water withdrawals in the project area, the effects of solid waste landfills on surface water quality, the effects of subsurface sanitary wastewater disposal on surface water quality, and an inventory of land use characteristics upstream from water quality monitoring stations. To prevent groundwater contamination problems from developing in the area, the introduction of a systematic plan to close inferior landfill sites and develop regional facilitates with the proper environmental controls is recommended. There are 28 major mainland drainage basins within the county. The population is growing at a higher rate than any other county in the state, which is putting pressure on resources. Baseline data, stored in the state's STORET computer, were from geographical, climatological, hydraulic, and water quality sources. Of the 21 parameters measured, time permitted evaluation of only five for this report. (Garrison-Omniplan)
W84-03677

TUG HILL RESOURCE MANAGEMENT PLAN.
Cooperative Tug Hill Planning Board, Loraine, NY.
Report, 1976. 82 p, 14 Fig, 15 Ref, 7 Append.

Descriptors: *Resources management, *Regional planning, *Land use, *Natural resources, Social needs, Human population, Agriculture, Forests, Transportation, Recreation, Streams, Economic aspects, Soil types, Slopes, Wetlands, Climatic data.

In June 1974 the Town of Redfield, New York, invited neighboring towns to meet and discuss working together to plan the future direction of land use for central Tug Hill. The Cooperative Tug Hill Planning Board held its first official meeting October 7, 1974. The nine participating towns shared the central Tug Hill forest and watersheds. The Plan which this document presents is based on an inventory of natural resources and a review of man's current impact on the land. For each of the towns, the planners gathered data on soil, slopes, water resources, forest classification and wildlife habitats, and climate. Maps depict the results of the inventories. In what has been called 'the core' lies one of the largest uninterrupted tracts of forest in New York State. The future water supply resource of the region is directly related to forest land use. Ten river systems have their headwaters in the core area. The plan components included social and economic considerations. Goals and objective with respect to major land use categories reflect the needs and aspirations of the residents as measured by questionnaire and a series of local meetings. The plan section of the document identifies future land use patterns proposed for Tug Hill. Some of the ways in which the towns may seek to implement the plan are described. (Fazio-Omniplan)
W84-03694

EFFECT OF AN IMPOUNDMENT ON THE UPSTREAM AND DOWNSTREAM FISH TAXOCENES (SPEED RIVER, ONTARIO, CANADA),
Lodz Univ. (Poland). Inst. of Environmental Biology.
T. Penczak, R. Mahon, and E. K. Balon.
Archiv fur Hydrobiologie, Vol. 99, No. 2, p 200-207, January, 1984. 4 Tab, 16 Ref.

Descriptors: *Fish populations, *Dam effects, *Environmental effects, *Speed River, *Ontario, Species diversity, Turbidity, Density, Guelph Reservoir, Reservoir releases.

Changes were noted in fish taxocenes at two localities, one upstream and the other downstream, after damming of the Speed River had been completed. The collection locations were about 5 km upstream and 1 km downstream of the Guelph Reservoir of the upper Speed River watershed. Upstream species composition changed only slightly, but the total population biomass increased 3.5 times, probably as a result of an increase in density rather than as a result of increased growth rates. Downstream new species were found and four previously dominant species were absent, probably due to the cold hypolimnial water released from the reservoir. Disturbances or declines in reproduction of several species were noted. In spite of this the production increased 3.2 times. As two years and 8 months have elapsed since the dam was finished, it appears that repopulation of the sections has been completed. (Baker-IVI)
W84-03747

SOME ENVIRONMENTAL ASPECTS OF PROPOSED HYDROELECTRIC SCHEMES ON THE ZAMBEZI RIVER, ZIMBABWE,
Zimbabwe Univ., Mount Pleasant. Dept. of Biological Sciences.
R. F. Du Toit.
Biological Conservation, Vol. 28, No. 1, p 73-87, 1984. 3 Fig, 12 Ref.

Descriptors: *Hydroelectric plants, *Environmental effects, *Dam effects, *Zambezi River, *Zimbabwe, Wildlife, Wilderness areas.

Preliminary environmental impact studies of proposed additional hydroelectric schemes to meet the growing electricity demand of Zimbabwe have shown that one particular scheme poses a serious threat. This scheme, at Mupata Gorge, threatens the wilderness character and wildlife resources of the middle Zambezi valley. The Mupata scheme would flood a portion of the Zambezi Valley below Lake Kariba. An alternative scheme, located at Batoka Gorge, would entail much less environmental cost. The dam in Batoka Gorge would be sited about 50 km downstream of the Victoria Falls, and would be nearly 200 m high. The lake would be less than 1 km wide along most of its length. Likely impacts of these schemes on mammals, birds, fish, terrestrial and aquatic vegetation, human health and other environmental aspects are considered. Further environmental research is recommended before a final decision can be made. (Baker-IVI)
W84-03860

CHATTANOOGA SHALE EXPLOITATION AND THE AQUATIC ENVIRONMENT: THE CRITICAL ISSUES,
Oak Ridge National Lab., TN. Environmental Sciences Div.
G. K. Eddlemon, and V. R. Tolbert.
Environment International, Vol. 9, No. 2, p 85-95, 1983. 4 Fig, 3 Tab, 59 Ref. Department of Energy contract W-7405-eng-26.

Descriptors: *Oil shale, *Aquatic environments, Environmental effects, Environmental impact statement, Erosion, Sedimentation, Acid mine drainage, Leachates, Solid waste disposal, Tennessee, Kentucky, Alabama.

Early identification of the critical environment issues arising from new energy technologies is needed to ensure adequate consideration of these issues in all phases of research and development. This study examines the potential hazards to aquatic ecosystems from large-scale exploitation (190,000 Mg/day) of the Chattanooga Shale Formation, an immense reserve of oil shale and uranium in Kentucky, Tennessee, and Alabama. Using existing data on regional ecology, hydrology, mining operations, and raw and spent shale chemistry, we identified two major, related environmental issues: (1) the potential for extensive adverse

effects on aquatic communities through degradation of water quality and habitat; and (2) the potential conflict between the requirements for shale exploitation, and the habitat and water quality needs of threatened or endangered species. Specific hazards to aquatic ecosystems include erosion, sedimentation, acid mine drainage, raw and spent shale leachates, and surface disposal of immense quantities of solid wastes. Twelve of 19 federally designated, threatened or endangered fish and mollusks in the shale-bearing region were identified as known or recent inhabitants of the counties believed to be most favorable for the exploitation of shale. Of these, five species occur as single populations or are limited to a single river system. The potential for adverse effects on these species is greatest in the counties near the Tennessee-Alabama state line. Future research needs include physical, chemical, and toxicological characterizations of shale leachates and studies of the transport and fate of leachable contaminants. Such research can provide the guidance necessary to minimize impacts on aquatic communities resulting from extraction, retorting, and disposal of shale. (Author's abstract)
W84-03887

ASSESSMENT OF RIVER CHANNELIZATION IN ENGLAND AND WALES,
Southampton Univ. (England). Dept. of Geography.
A. Brookes, K. J. Gregory, and F. H. Dawson.
The Science of the Total Environment, Vol. 27, No. 2/3, p 97-111, 1983. 2 Fig, 4 Tab, 56 Ref.

Descriptors: *Channelization, *Environmental effects, *England, *Wales, Rivers, Flood control, Drainage, Navigation, Channel erosion.

The effects of river channelization were surveyed in the United Kingdom by reviewing data collected from annual reports at various water authorities. Far fewer studies on the effects of channelization have been performed in England and Wales than is true for the North American rivers. River channelization in England and Wales was undertaken for the purpose of reduction or alleviation of flooding, drainage of agricultural land, benefit of navigation, or reduction or prevention of erosion. Although channel modification has occurred for several centuries, it is only since about 1930 after the Report of the Royal Commission on Land Drainage in England and Wales that a period of intense activity involving substantial lengths of river occurred. It is suggested that surveys of the extent and character of channelization are needed to aid is assessing the magnitude of channelization effects and to consider the relative merits of alternative channelization strategies. (Baker-IVI)
W84-03992

EFFECTS OF DREDGING ON ADJACENT WATERS,
Tulane Univ., New Orleans, LA.
C. Grimwood.
Journal of Environmental Engineering, Vol. 109, No. 1, p 47-65, February, 1983. 16 Fig, 15 Ref.

Descriptors: *Dredging, *Ocean dumping, *Environmental effects, *New Orleans, *Louisiana, *Mississippi river, Fate of pollutants, Sediments, Dilution, Waste disposal.

Large volumes of material are dredged each year during the development and maintenance of waterways and harbors. An intensive monitoring program was conducted prior to, during, and after dredging operation in the Mississippi River and other waterways in the New Orleans District of the Army Corps of Engineers. The concentration of pollutants found in the bottom sediment material to be excavated are several orders of magnitude higher than those present in the dredge effluent and are not good indicators of the potential release of these constituents into the water column. The standard elutriate is generally a good simulator of the dredge effluent. In the Mississippi River at New Orleans, the effect of discharging dredge effluent from the pipeline of a cutterhead dredge on the concentration of constituents is short-lived and usually completely disappears at distances greater than 60 ft (18.3 m) downstream from the discharge pipe. The material released from a hopper dredge during ocean dumping operations settles at a rapid rate, and the diffusion and dispersion of the constituents of interest is negligible and confined to the boundaries of the release zone. Even though large volumes of botton material are resuspended during agitation dredging, the effects of this material on channel waters are transient, and normal conditions are restored within a short period of time. Generally, the material dredged during these investigations did not present a hazardous waste disposal problem, as dilution was rapid and increased concentrations of pollutants were confined to the disposal area or mixing zone. (Moore-IVI)
W84-04044

SUITABILITY ANALYSIS FOR SELECTION OF PIPELINE ROUTES,
Louisiana State Univ., Baton Rouge. Dept. of Petroleum Engineering.
C. A. Whitehurst, and R. A. Kinney.
Water Resources Bulletin, Vol. 20, No. 1, p 1-8, February, 1984. 6 Fig, 5 Tab, 13 Ref.

Descriptors: *Environmental effects, *Pipelines, *Louisiana, *Suitability analysis, Construction, Site selection, Drainage, Water quality.

A brief review of environmental assessment methods is presented as an introduction to a study of environmental management problems in a coastal area of southern Louisiana. The assessment method used in the study is called suitability analysis and involves the use of matrices. The matrix approach is simply a convenient method for organizing all factors representing environmental concerns in a region. The matrices proved to be very useful in defining the present state of an environmental regime and in maintaining an inventory of regional features and potential impacts. The method is described in detail and illustrated by evaluating the potential impacts of a major pipeline construction job in the area. Of major concern is the potential impact on the water resources of the region. Disruption to the natural drainage could be detremental, and affect the suitability of available water for a given use. Limitations of the method are discussed and potential areas for improvements and research are noted. Coupled with an economic assessment, the suitability analysis method should prove beneficial for selecting development sites for industries, residential areas, and other construction activities. (Author's abstract)
W84-04097

7. RESOURCES DATA

7A. Network Design

PRELIMINARY SEDIMENT NETWORK EVALUATION FOR THE PICEANCE BASIN, NORTHWESTERN COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
J. E. Kircher, and P. Guerard.
USGS Water-Resources Investigations Report 82-4046, 1982. 25 p, 11 Fig, 8 Tab, 13 Ref.

Descriptors: *Sediment discharge, Statistical analysis, Regional analysis, Mathematical studies, *Network design, Piceance Creek, Yellow Creek, *Colorado.

Statistical relationships were developed between suspended-sediment discharge and several regional factors of climate, physiography, and land use in the Piceance basin, northwestern Colorado. The purpose of the study was to evaluate the existing sediment collection network, especially in regard to detecting changes in suspended-sediment discharge due to the development in the basin. Spatial- and time variability were examined using multiple linear regression techniques. Because of the short period of record, monthly mean sediment loads were used to determine shifts or changes in trends due to mining and related activities in the basin. Dummy variable analysis was used to detect these premining and postmining differences in the regression lines and also to detect seasonal differences in the sediment discharge. Differences did exist in the sediment discharge from season to season and before and after mining; however, due to the variability and short period of record the cause of these differences could not be adequately determined. Part of the high variability in sediment discharge was due to variability in the water discharge. Therefore, if the network is to be improved, the emphasis needs to be on improvement of the water-discharge. The results of the monthly mean regression analysis were used in the mean monthly and mean annual analysis for determination of initial network design equations. These were only preliminary in nature and could be improved with additional data. (USGS)
W84-03585

HYDROLOGIC-INFORMATION NEEDS FOR OIL-SHALE DEVELOPMENT, NORTHWESTERN COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
USGS Water-Resources Investigations Report 82-4076, 1982. 92 p, 30 Fig, 5 Tab, 69 Ref. Compiled by Taylor, O. J.

Descriptors: *Oil shale, Drilling, *Aquifer testing, Mine drainage, *Groundwater availability, Water quality, Benthic fauna, Suspended sediments, Surface runoff, Springs, Acid rain, Spoil disposal, Waste disposal, *Colorado, Piceance basin.

Hydrologic information is not adequate for proper development of the large oil-shale reserves of Piceance basin in northwestern Colorado. Exploratory drilling and aquifer testing are needed to define the hydrologic system, to provide wells for aquifer testing, to design mine-drainage techniques, and to explore for additional water supplies. Sampling networks are needed to supply hydrologic data on the quantity and quality of surface water, ground water, and springs. A detailed sampling network is proposed for the White River basin because of expected impacts related to water supplies and waste disposal. Emissions from oil-shale retorts to the atmosphere need additional study because of possible resulting corrosion problems and the destruction of fisheries. Studies of the leachate materials and the stability of disposed retorted shale piles are needed to insure that these materials will not cause problems. Hazards related to in-situ retorts, and the wastes related to oil-shale development in general also need further investigation. (USGS)
W84-03608

COMPARISON OF MULTIPLATE AND SURBER SAMPLERS IN A COLORADO MOUNTAIN STREAM,
Chadwick and Associates, Littleton, CO.
J. W. Chadwick, and S. P. Canton.
Journal of Freshwater Ecology, Vol. 2, No. 3, p 287-292, December, 1983. 1 Fig, 2 Tab, 20 Ref.

Descriptors: *Mountain streams, *Sampling, *Colorado, *Invertebrates, Substrates, Rocky Mountains, Surber samplers, Multiplate samplers, Seasonal variations, Streams.

Comparisons of Surber sampling of natural substrates and multiplate artificial substrates for invertebrates were made in Trout Creek, a mountain stream in northwest Colorado. Over the year long study, multiplate samplers produced generally similar trends in benthic density, biomass and number of species when compared to Surbers, although values for multiplates were usually lower. Seasonal patterns exhibited basically opposite trends at all stations. Coefficient of variability calculations showed that the multiplates gave significantly lower variability than Surbers only for biomass, but not for density and number of species. The lack of the expected consistently reduced variabiliy on the plates may be due to the proximity of the samples to the substrate. In this study multiplate samplers provided little additional information compared to Surber sampling of natural substrates and did not significantly reduce sample variability. Yet the plates still required extra field

time for placement, colonization, and retrieval. Because of this, multiplate samplers do not appear to offer any distinct advantages over Surber sampling of natural substrates in Rocky Mountain streams. (Baker-IVI)
W84-03958

STATUS OF IRRIGATION AND DRAINAGE RESEARCH IN THE UNITED STATES.
Journal of Irrigation and Drainage Engineering, Vol. 110, No. 1, p 55-74, March, 1984. 4 Tab, 13 Ref.

Descriptors: *Irrigation, *Drainage, *Research priorities, Irrigation management, Water use, Soil salinity, Water quality, Soil conservation, Water conservation.

High priority research objectives for irrigation and drainage in the United States are identified. These include: (1) development of more efficient irrigation distribution and on-farm systems and management practices to increase water use efficiency, control soil salinity, and reduce degradation of downstream water quality; (2) development of improved and new technology to conserve and manage soil and water resources to enhance soil productivity and improve production efficiency; (3) development of improved systems and practices to store and deliver water supplies to farms as needed for efficient crop production; and (4) development of more efficient drainage systems and practices to control soil water for crop production in humid regions. Current national and regional research programs are described. (Author's abstract)
W84-04094

7B. Data Acquisition

ELECTROCHEMICAL INSTRUMENTATION SYSTEM FOR OPTIMIZING IRRIGATION SCHEDULES, PHASE III,
Arizona Univ., Tucson.
W. G. Gensler.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84-154392, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Research Center Completion Report, January, 1984. 17 p, 10 Fig, 6 Ref. Project No. OWRT A-110-ARIZ (1), Contract/Grant No. 14-34-0001-1103.

Descriptors: *Electrochemistry, Polentrometric level, Electrodes, Irrigation water, Plant growth, *Instrumentation, Irrigation schedules, Optimization, Telemetry, *Remote sensing.

The emphasis in this phase of the project was threefold: 1. to develop an agronomic standard for calibration of the electrochemical sensors, 2. to design and construct a prototype agricultural telemetry system and assess its economic feasibility, 3. to determine the fundamental electrochemical origin of the electropotentials. An agronomic standard has been developed based on the use of stem diameter measurements. Part of a prototype agricultural telemetry system has been constructed and tested. Cyclic voltammetry was implemented to determine the electrochemical origin of the electro-potential and further work in multi step, twin cell coulometry is well under way.
W84-03667

MODELLING DAILY EVAPOTRANSPIRATION USING REMOTELY SENSED DATA,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
R. J. Gurney, and P. J. Camillo.
Journal of Hydrology, Vol. 69, No. 1-4, p 305-324, February, 1984. 6 Fig, 6 Tab, 13 Ref. Goddard Space Flight Center contract NAS5-24350.

Descriptors: *Model studies, *Evapotranspiration, *Remote sensing, Mathematical models, Soil water, Temperature, Wheat, Barley, Eddies, Hannover, Federal Republic of Germany.

Evaporation and soil-moisture status are important hydrological parameters which are difficult to estimate conventionally over large areas. There are some indications that remotely-sensed measurements may be able to assist in their estimation for these large areas. An energy-balance model is used to estimate daily evapotranspiration for 3 days for a barley field and a wheat field near Hannover, Federal Republic of Germany. The model was calibrated using once-daily estimates of surface temperatures, which may be remotely sensed. The evaporation estimates were within the 95% error bounds of independent eddy correlation estimates for the daytime periods for all 3 days for both sites, but the energy balance, estimates are generally higher; it is unclear which estimate is biassed. Soil moisture in the top 2 cm of soil, which may be remotely sensed, may be used to improve these evaporation estimates under partial ground cover. (Murphy-IVI)
W84-03790

BARE-SOIL EVAPORATION DETERMINED IN SITU BY INFRARED THERMOMETRY,
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
For primary bibliographic entry see Field 2D.
W84-03791

MODERN TOOLS CUT THE COST OF WATER EXPLORATION AND EVALUATION,
Atlas Copco A.B., Stockholm (Sweden).
B. Tornqvist.
The Johnson Driller's Journal, Vol. 55, No. 2, p 4-7, 1983. 2 Fig.

Descriptors: *Measuring instruments, *Well logs, *Remote sensing, *Water resources development, *Exploration, Groundwater, Aquifer characteristics.

A complete program for evaluation of groundwater reaources in areas where little work has been undertaken starts with a general reconnaissance study followed by more detailed surveys in selected areas. The third stage is test drilling, pumping and water balance calculations. The results of these guide the final development phases. The wide variety of scientific and technical tools developed and used in recent years in the search for and the evaluation of groundwater resources are reviewed. The tools range from satellite photography of the ground surface to well logging below the surface. Techniques discussed include infrared sensitive film mapping, magnetic survey methods, electrical method to provide indirect evidence of subsurface aquifers, resistivity measurements, tracing of electric current at the surface, use of information from seismic waves, and types of geophysical logging. (Baker-IVI)
W84-03951

CORRECTION OF MEASURED PRECIPITATION IN THE ALPS USING THE WATER EQUIVALENT OF NEW SNOW,
Eidgenoessische Technische Hochschule, Zurich (Switzerland).
For primary bibliographic entry see Field 2C.
W84-03976

PORTABLE, COMPUTERIZED MONITOR KEEPS TABS ON WATER,
Michigan Univ., Ann Arbor. School of Public Health.
R. A. Deininger.
Water Engineering and Management, Vol. 131, No. 2, p 32-33, 53, February, 1984. 3 Fig, 3 Tab.

Descriptors: *Monitoring, *Water quality control, Computers, Measuring instruments, Data processing, Data acquisition.

Recent events of the microcomputer age have made available inexpensive and mobile computing power, which significantly extends the data-logging and analysis capabilities of water quality monitors. A system is described which will monitor the water quality at a given location continuously over time, record all data collected in machine-readable form, transmit the data once collected to a central computing system, and be mobile enough that it could be taken to any location at a river and also on a boat. The microcomputer is an APPLE II with 48 K bytes of memory and a single floppy disk drive. Operating the system is quite simple and several programs have been written in BASIC, which allow the storage and retrieval of the data. Two programs are shown - the water quality monitoring program and the one which retrieves the data from the disk. The system has been successfully used at a fixed location and from a boat. (Baker-IVI)
W84-04004

EXPERIMENTAL STUDIES IN NATURAL GROUNDWATER RECHARGE DYNAMICS: ASSESSMENT OF RECENT ADVANCES IN INSTRUMENTATION,
Kansas State Geological Survey, Lawrence.
M. Sophocleous, and C. A. Perry.
Journal of Hydrology, Vol. 70, No. 1-4, p 369-382, 1984. 9 Fig, 6 Ref.

Descriptors: *Instrumentation, *Sensors, *Monitoring, *Groundwater recharge, Logging (recording), Data collection, Meteorological data collection, Automation.

Two sites in southcentral Kansas were instrumented with various modern sensors and data microloggers. Data from the sensors were collected using microloggers in combination with magnetic-cassette tape, graphical and digital recorders, analog paper-tape recorders, and direct observations to evaluate and automate data collection and processing. Atmospheric sensors included an anemometer, a tipping-bucket raingage, an air temperature thermistor, a relative-humidity probe, a net radiometer, and a barometric-pressure transducer. Sensors in the unsaturated zone consisted of soil-temperature thermocouples, tensiometers coupled with pressure transducers and dial gages, gypsum blocks, and a neutron moisture probe operated by an observer. The saturated-zone sensors consisted of a water-level pressure transducer, a conventional float gage connected to a variable potentiometer, soil thermocouples, and a number of multiple-depth piezometers. Certain types of equipment such as pressure transducers are very sensitive to environmental conditions. Extraordinary steps had to be taken to protect some of the equipment, whereas other equipment seemed to be reliable under all conditions. In order to enhance the reliability of the system and to minimize data losses, sensors and data loggers should be purchased from reputable firms, and back-up systems should be arranged. Shock and polarity protection is essential for electronic equipment. The unit housing the data loggers and all electric connections must be insulated against moisture and temperature fluctuations. (Moore-IVI)
W84-04162

NEW AMPOULE TYPE WATER SAMPLER FOR MICROBIOLOGICAL STUDY IN AQUATIC ENVIRONMENTS,
Nagoya Univ. (Japan).
H. Terai, and Y. Saijo.
Japanese Journal of Limnology, Vol. 44, No. 4, p 341-344, October, 1983. 3 Fig, 12 Ref.

Descriptors: *Sampling, *Biological samples, Aquatic environment, Lakes, Limnology.

An aseptic water sampler has been devised for making microbiological investigations more effective in aquatic environments. The sampler uses glass ampoules as sampling vessels. The new sampler resembles Sorokin's sampler as it employs the same use of evacuated glass ampoules for sampling vessels and the device of serial sampling, but has a stainless-steel cylinder in which three ampoules are inserted with only one cylindrical messenger to snap off the glass capillary. The new device has been used for studies on Lake Kizaki since 1976. (Baker-IVI)
W84-04171

7C. Evaluation, Processing and Publication

GEOLOGIC AND WELL-CONSTRUCTION DATA FOR THE H-8 BOREHOLE COMPLEX NEAR THE PROPOSED WASTE ISOLATION PILOT PLANT SITE, SOUTHEASTERN NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 2F.
W84-03555

MEAN ANNUAL RUNOFF AND PEAK FLOW ESTIMATES BASED ON CHANNEL GEOMETRY OF STREAMS IN NORTHEASTERN AND WESTERN MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 2E.
W84-03556

DRAINAGE DIVIDES, MASSACHUSETTS--BLACKSTONE AND THAMES RIVER BASINS,
Geological Survey, Boston, MA. Water Resources Div.
B. E. Krejmas.
USGS Open-File Report 82-631, 1982. 12 sheet maps, 1 Fig.

Descriptors: *Blackstone River, French River, Quinebaug River, eastern Hampden County, eastern Hampshire County, southern Middlesex County, southern Worcester County, western Norfolk County, *Drainage basins, *Surface waters, *Massachusetts, Sites, Hydrologic data, *Maps.

Drainage boundaries for selected subbasins of the Blackstone and Thames River basins in eastern Hampden, eastern Hampshire, western Norfolk, southern Middlesex, and southern Worcester Counties, Massachusetts, are delineated on 12 topographic quadrangle maps at a scale of 1:24,000. Drainage basins are shown for all U.S. Geological Survey data-collection sites and for mouths of major rivers. Drainage basins are shown for the outlets of lakes or ponds and for streams where the drainage area is greater than 3 square miles. Successive sites along watercourses are indicated where the intervening area is at least 6 miles on tributary streams or 15 square miles along the Blackstone River, French River, or Quinebaug River. (USGS)
W84-03558

GEOLOGIC AND WELL-CONSTRUCTION DATA FOR THE H-9 BOREHOLE COMPLEX NEAR THE PROPOSED WASTE ISOLATION PILOT PLANT SITE, SOUTHEASTERN NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 2F.
W84-03561

WATER LEVELS IN NASSAU COUNTY SEWER DISTRICTS 2 AND 3, LONG ISLAND, NEW YORK, 1978-1979,
Geological Survey, Syosset, NY. Water Resources Div.
H. F. H. Ku, and D. L. Simmons.
USGS Water-Resources Investigations Report 82-4017, 1983. 30 p, 2 Fig, 2 Tab, 15 Ref.

Descriptors: *Water-level fluctuations, Wells, Groundwater, Base flow, Glacial aquifers, *New York, Long Island, Nassau County.

Prior to development on Long Island, about 95 percent of total streamflow originated as groundwater seepage from the upper glacial aquifer; the remaining 5 percent consisted of direct storm runoff. Thus, the streams on Long Island function as groundwater drains. Their flow in dry weather is directly controlled by groundwater levels adjacent to the stream channels. Sewage systems in Nassau County have caused a general lowering of groundwater levels, which in turn has severely reduced streamflow. This report presents monthly water-level measurements in 259 wells in Nassau county from 1978-79 to provide a data base to evaluate the need to replace streamflow lost through lowering of the water table. (USGS)
W84-03563

UNCERTAINTIES IN RECORDS OF ANNUAL MEAN DISCHARGE IN MAINE,
Geological Survey, Augusta, ME. Water Resources Div.
R. A. Fontaine.
USGS Water-Resources Investigations Report 83-4025, April, 1983. 108 p, 3 Fig, 55 Tab, 5 Ref.

Descriptors: *Hydrologic data, *Stream discharge, *Stream gages, *Errors, *Maine, Network analysis, Annual mean discharge.

This report documents the results of rating analyses of flow during periods of ice-cover at 33 stations on selected rivers in Maine. Results were obtained through linear multiple regression. It also presents functions relating uncertainties in records to the number of discharge measurements made at these and 21 other stations. The application is unusual in that it includes analysis of the uncertainty of discharge as affected by backwater from ice. Total uncertainty consists of errors incurred during measurement and during data processing. An average of 46.8 percent of the total variance for the 21 stations not affected by backwater was due to measurement variance, and 53.2 percent was due to process variance. Data from the remaining 33 stations were divided into summer (open-water) periods and the winter (backwater) periods. An average of 49.3 percent of the total variance for the summer-period stations was due to measurements variance; 50.7 percent was due to process variance. An average of 25.2 percent of the total variance for the winter-period stations was due to measurement variance; 74.8 percent was due to process variance. Results of the seasonal division of average variance suggest that the process and measurement variances are essentially equal during open-water periods and that process variance is considerably greater than the measurement variance during backwater periods. The errors in winter discharge records significantly increased average uncertainty in the records of annual mean discharge. (USGS)
W84-03564

WATER RESOURCES OF THE TRUK ISLANDS,
Geological Survey, Honolulu, HI. Water Resources Div.
O. Van der Brug.
USGS Water-Resources Investigations Report 82-4082, 1983. 223 p, 36 Fig, 81 Tab, 38 Ref.

Descriptors: *Hydrologic data, Weather data, Geology, Water resources development, *Data collection, *Pacific Islands, *Truk Islands.

The Truk Islands, part of the Caroline Islands in the western Pacific, consist of 19 volcanic islands and about 65 coral islets. The volcanic islands and some of the coral islets are scattered in an 820-square-mile lagoon enclosed by a 125-mile long barrier reef. Moen, although not the largest, is by far the most developed island and is the adminstrative, commercial, educational, and transporation center of the islands. Monthly rainfall records for most years are available since 1903. Rainfall-runoff comparisons show that about half the annual rainfall runs off as surface water into Truk Lagoon. Flow characteristics of the major streams, based on more than 11 years of record, are provided and the application of data for possible use in the design of reservoirs and rain catchments is included. Historical and present development of all water sources is given. The chemical analyses of surface and ground water on Moen, with the exception of water from well 9, show the good quality of the water sources. This report summarizes all hydrologic data collected and provides interpretations that can be used for development and management of the water resources. (USGS)
W84-03565

USE OF DIGITAL LAND-COVER DATA FROM THE LANDSAT SATELLITE IN ESTIMATING STREAMFLOW CHARACTERISTICS IN THE CUMBERLAND PLATEAU OF TENNESSEE,
Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 2E.
W84-03566

WATER RESOURCES OF THE YAP ISLANDS,
Geological Survey, Honolulu, HI. Water Resources Div.
O. Van der Brug.
USGS Water-Resources Investigations Open-File Report 82-357, 1983. 187 p, 3 Fig, 75 Tab, 31 Ref.

Descriptors: *Hydrologic data, Geology, Water resources development, *Data collection, *Pacific Islands, *Yap Islands.

The Yap Islands consist of four major islands, Yap, Gagil-Tomil, Map, and Rumung. Of these, Yap Island has more than half the total land area, most of the population, and almost all of the economic development. The islands of Map and Rumung together compose only 15 percent of the land area and population and are not discussed in this report. This report summarizes the hydrologic data collected and provides interpretations that can be used by the planning and public works officials of Yap to make decisions concerning development and management of their water resources. Included are a summary of streamflow characteristics, based on more than 12 years of record, and a compilation and interpretation of the available ground-water and water-quality information. Monthly rainfall totals for most years since 1900 are tabulated and rainfall-runoff comparisons are made. Available data on evaportation and water and air temperatures are summarized. Application of the data for use in the design of reservoirs and rain catchments is discussed and is augmented by tables and illustrations. (USGS)
W84-03568

YEARLY VARIATIONS IN RUNOFF AND FREQUENCY OF DRY YEARS FOR CONTERMINOUS UNITED STATES, 1911-79,
Geological Survey, Reston, VA. Water Resources Div.
W. B. Langbein, and J. R. Slack.
Available from the Ofss, USGS, Box 25425, Lakewood, CO 80225, Price; $11.25 in paper copy, $3.50 in microfiche. USGS Open-File Report 82-751, 1982. 85 p, 73 Fig, 3 Tab, 5 Ref.

Descriptors: *Streamflow, Drought, *Variability, Spatial distribution, Temporal distribution, *Runoff frequency, United States, Canada, *Data collection, Historical data.

Gaging-station data are presented on variations in annual runoff over the conterminous United States and nearby Canada during the period 1911-79 in tabular and graphic (map) form. These data bring up-to-date and extend backward in time previous reports on streamflow stations by Harbeck and Langbein in 1949 which covered the period 1921-45 and that by Busby in 1963 which covered the period 1931-60. As depicted in Langbein and Slack (1980), these data show that, contained within a rather large seemingly random or sporadic pattern, there appears to be a previously unnoticed degree of similarity in the occurrence of subnormal flows across the country. In each of three regions, viz., West, Center, and East, dry years were concentrated in two sequences, one centered in the 1930's and the second in the decade from the mid-50's to the mid-60's. (USGS)
W84-03569

SIMULATED CHANGES IN WATER LEVEL IN THE MINJUR AQUIFER, RIYADH AREA, SAUDI ARABIA,
Geological Survey, Riyadh (Saudia Arabia). Water Resources Div.
For primary bibliographic entry see Field 2F.
W84-03571

NUMERICAL SIMULATION OF THE ALLUVIUM AND TERRACE AQUIFER ALONG THE NORTH CANADIAN RIVER, CANTON LAKE TO LAKE OVERHOLSER, CENTRAL OKLAHOMA,
Geological Survey, Oklahoma City, OK. Water Resources Div.
For primary bibliographic entry see Field 2F.
W84-03572

JANUARY 1983 WATER LEVELS, AND DATA RELATED TO WATER-LEVEL CHANGES, WESTERN AND SOUTH-CENTRAL KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
M. E. Pabst.
USGS Open-File Report 83-762, 1983. 164 p, 2 Fig, 1 Tab, 14 Ref.

Descriptors: *Groundwater, *Water level changes, *Hydrologic data, *Kansas, Data collection.

Water-level measurements were made, mostly in January 1983, in about 1,540 wells in western and south-central Kansas. The measurements were made in mid-winter when pumping was minimal and water levels had recovered, for the most part, from the effects of pumping during the previous irrigation season. Annual hydrologic data are provided for relating water-level changes from a 'base-reference year' (predevelopment year), a year of abnormally high rainfall and minimum pumpage (1966 or 1974) and each of seen consecutive years of measurement (1977-83). The 'base-reference year' is designated as 1940 for the southwestern area, 1944 for the south-central area, and 1950 for the northwestern and west-central areas. Water levels for the 'base-reference year' are established by measurements made during that year and by interpretation of maps showing water-level altitudes. Data also are provided for relating the average annual water-level changes, saturated thicknesses of the deposits, and percentage changes in saturated thicknesses. (USGS)
W84-03579

WATER-RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN WYOMING, FISCAL YEARS 1981 AND 1982.
Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 2E.
W84-03580

DATA SUPPLEMENT TO: QUALITY OF COAL MINE DRAINAGE IN WASHINGTON, 1975-77,
Geological Survey, Tacoma, WA. Water Resources Div.
L. A. Fuste', F. A. Packard, M. O. Fretwell, and D. P. Garland.
USGS Open-File Report 83-205, 1983. 61 p, 10 Fig, 21 Tab, 8 Ref.

Descriptors: Mine wastes, *Mine drainage, *Coal mines, *Water quality, Biological samples, *Chemical analysis, Discharge measurement, Physical properties, *Washington, Coal-bearing areas.

From December 1975 to September 1977 the U.S. Geological Survey studied coal mine drainage in western Washington to 1) characterize the water quality of drainage from abandoned mines in the 11 coal-bearing areas of the State; 2) examine the water quality effects on a stream receiving drainage from an abandoned coal mine; 3) determine the baseline water-quality conditions at two prospective underground coal mine areas; and 4) recommend procedures for monitoring stream quality in the baseline areas in the event that mining occurs. This report presents physical, chemical, and biological data collected during the study period from Gallop Creek (Whatcom County), Loretta Creek (Skagit County), and Wilkeson Creek (Pierce County) and from 100 abandoned coal mines in western Washington, and from a borehole hydraulic-mining test site. Biological information included taxonomic identifications and counts of benthic invertebrates and periphytic algae. (USGS)
W84-03581

WATER QUALITY OF SOMERVILLE LAKE, SOUTH-CENTRAL TEXAS,
Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 2H.
W84-03583

WATER QUALITY AND OTHER HYDROLOGIC DATA COLLECTED IN AND AROUND A SURFACE COAL MINE, CLAY AND VIGO COUNTIES, INDIANA, 1977-80,
Geological Survey, Indianapolis, IN. Water Resources Div.
L. L. Bobo, and S. E. Eikenberry.
Available from the Ofss, USGS, Fed. Ctr. Lakewood, CO 80225, Price: $15.75 in paper copy, $3.50 in microfiche. USGS Open-File Report 82-639, October, 1982. 117 p, 5 Fig, 34 Tab, 23 Ref.

Descriptors: *Aquifers, Assessments, *Coal mines, Confined aquifers, Data collections, Dissolved oxygen, Geohydrology, *Groundwater, Heavy metals, *Indiana, Iron, Land use, *Mine drainage, Observation wells, Precipitation, Strip mines, Water level, Watersheds, Active mining, Honey Creek, North Branch Honey Creek, Reclaimed coal-mine land, Stone Quarry Branch, Surface coal-mine land, Unreclaimed surface coal-mine-land.

Few data are available for evaluating water-quality and other hydrologic properties in and around surface coal mines, particularly in areas where material having a high potential for acid-production is selectively buried. This report contains hydrologic data collected in an active coal mining area in Clay and Vigo Counties, Indiana, from September 1977 through February 1980. Methods of sampling and analysis used in collecting the data also are summarized. The data include field and laboratory measurements of water at 41 wells and 24 stream sites. Variables measured in the field include water temperature, specific conductance, pH, Eh, dissolved oxygen, ground-water levels, and streamflow; and in the laboratory, concentrations of major ions, alkalinity, hardness, trace elementsl, organic carbon, phosphorus, and dissolved solids. Other variables measured in the laboratory include ferrous iron concentration of water samples from selected wells, percent sulfur by weight and the potential acidity of core samples of reclaimed cast overburden, concentrations of elements absorbed on streambed materials, concentrations and particle size of suspended sediment in water, and populations and Shannon diversity indices of phytoplankton in water. Dissolved-solids concentrations and pH of ground water ranged from 173 to 5,130 milligrams per liter and from 6.1 to 8.9, respectively, and of surface water, from 120 to 4,100 milligrams per liter and from 6.1 to 8.8 respectively. (USGS)
W84-03597

DRAINAGE DIVIDES, MASSACHUSETTS--HOUSATONIC RIVER BASIN,
Geological Survey, Boston, MA. Water Resources Div.
A. Gadoury, and S. Wandle, Jr.
USGS Open-File Report 82-634, 1982. 12 sheet maps, 14 Fig.

Descriptors: *Drainage basins, *Surface waters, *Massachusetts, Sites, Hydrologic data, *Maps, *Housatonic River, Berkshire County.

Drainage boundaries for selected subbasins in Berkshire County, Massachusetts, are delineated on 12 topographic quadrangle maps at a scale of 1:24,000. Drainage basins are shown for all U.S. Geological Survey data-collection sites and for mouths of major rivers. Drainage basins are shown for the outlets of lakes or ponds and for streams where the drainage area is greater than 3 square miles. Successive sites along watercourses are indicated where the intervening area is at least 6 square miles on tributary streams or 15 square miles along the Housatonic River. (USGS)
W84-03598

DRAINAGE DIVIDES, MASSACHUSETTS--DEERFIELD AND MILLERS RIVER BASINS,
Geological Survey, Boston, MA. Water Resources Div.
B. E. Krejmas, and S. W. Wandle, Jr.
USGS Open-File Report 82-632, 1982. 16 sheet maps, 1 Fig.

Descriptors: *Drainage basins, *Surface waters, *Massachusetts, Sites, Hydrologic data, *Maps, Deerfield River, Millers River, Franklin County, Worcester County.

Drainage boundaries for selected subbasins in Franklin and northwestern Worcester Counties, Massachusetts, are delineated on 16 topographic quadrangle maps at a scale of 1:24,000. Drainage basins are shown for all U.S. Geological Survey data-collection sites and for mouths of major rivers. Drainage basins are shown for the outlets of lakes or ponds and for streams where the drainage area is greater than 3 square miles. Successive sites along watercourses are indicated where the intervening area is at least 6 square miles on tributary streams or 10 square miles along the Millers and Deerfield Rivers, or 20 square miles along the Connecticut River. (USGS)
W84-03599

DRAINAGE DIVIDES, MASSACHUSETTS--WESTFIELD AND FARMINGTON RIVER BASINS,
Geological Survey, Boston, MA. Water Resources Div.
R. A. Gadoury, and S. Wandle, Jr.
USGS Open-File Report 82-635, 1982. 15 sheet maps, 1 Fig.

Descriptors: *Drainage basins, *Surface waters, *Massachusetts, Sites, Hydrologic data, *Maps, Westfield River, Farmington River, Hampshire County, Hampden County, Berkshire County.

Drainage boundaries for selected subbasins in western Hampshire, western Hampden, and southeastern Berkshire Counties, Massachusetts, are delineated on 15 topographic quadrangle maps at a scale of 1:24,000. Drainage basins are shown for all U.S. Geological Survey data-collection sites and for mouths of major rivers. Drainage basins are shown for the outlets of lakes or ponds and for streams where the drainage area is greater than 3 square miles. Successive sites along watercourses are indicated where the intervening area is at least 6 square miles on tributary streams or 10 square miles along the Westfield or Farmington Rivers. (USGS)
W84-03600

ANALYSES OF ELUTRIATES, NATIVE WATER, AND BOTTOM MATERIAL IN SELECTED RIVERS AND ESTUARIES IN WESTERN OREGON AND WASHINGTON,
Geological Survey, Portland, OR. Water Resources Div.
G. J. Fuhrer, and F. A. Rinella.
USGS Open-File Report 82-922, 1983. 147 p, 20 Fig, 27 Tab, 6 Ref.

Descriptors: *Dredging, Environmental effects, Bottom sediments, Water quality, Coos River, *Oregon, Baker Bay, *Washington, Bonneville, Dam, Columbia River.

Chemical analyses of elutriates, bottom sediment and water samples for selected metals, nutrients and organic compounds including insecticides and herbicides have been made to provide data to determine short-term water quality conditions associated with dredging operations in rivers and estuaries. Between May and December 1980 data were collected as far south as the Coos River in Western Oregon, as far north as Baker Bay in Southwestern Washington and as far inland as Bonneville Dam on the Columbia River. In an elutriation test, bottom material from a dredging site is mixed with native water and the filtrate is analysed. Elutriation test results showed variability in concentrates of dissolved chemicals as follows: in micrograms per liter (micro g/l), manganese ranged from 0 to 10,000, iron from 10 to 4300, zinc from 1 to 90, and phenols from 9 to 420; in

milligrams per liter (mg/l), ammonia as nitrogen ranged from 0.03 to 46 and organic carbon from 0.5 to 45. (USGS)
W84-03601

GROUND WATER IN THE NORTHERN PART OF CLACKAMAS COUNTY, OREGON,
Geological Survey, Portland, OR. Water Resources Div.
For primary bibliographic entry see Field 2F.
W84-03602

GROUND-WATER RESOURCES OF THE RUTLAND AREA, VERMONT,
Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W84-03609

WATER RESOURCES DATA NEW YORK, WATER YEAR 1982: VOLUME 2. LONG ISLAND,
Geological Survey, Syosset, NY. Water Resources Div.
A. G. Spinello, J. H. Nakao, W. J. Flipse, Jr., and J. G. Carcaci.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84 119 536. USGS Water-Data Report NY-82-2, 1983. 312 p, 8 Fig, 1 Tab.

Descriptors: *New York, *Hydrologic data, *Groundwater, *Surface waters, *Water quality, Gaging stations, Streamflow, Flow rates, Lakes, Reservoirs, Chemical analysis, Sediments, Water temperature, Water analysis, Water levels, Water wells, *Data collections, Sites, Long Island streams.

Water resources data for the 1982 water year from New York consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; water quality of precipitation; and water levels and water quality of ground water wells. This volume contains records for water discharge at 17 gaging stations; water quality at 17 gaging stations, 349 wells, and 3 precipitation stations; and water levels at 117 observation wells. Also included are data for 77 low-flow partial-record stations. Additional water data were collected at various sites not involved in the systematic data collection program, and are published as miscellaneous measurements and analyses. (USGS)
W84-03610

WATER RESOURCES DATA NEW YORK, WATER YEAR 1982: VOLUME 3. WESTERN NEW YORK,
Geological Survey, Ithaca, NY. Water Resources Div.
J. B. Hood, W. H. Johnston, H. J. Zajd, Jr., and H. L. Dixson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84 119 544. USGS Water Data Report NY-82-3, 1983. 208 p, 5 Fig, 1 Tab.

Descriptors: *New York, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Streamflow, Flow rates, Gaging stations, Lakes, Reservoirs, Chemical analysis, Sediments, Water analysis, Water temperature, Water levels, Water wells, *Data collections, Sites, Susquehanna River basin, Ohio River basin, St. Lawrence River basin.

Water resources data for the 1983 water year for New York consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels of groundwater wells. This volume contains records for water discharge at 88 gaging stations; stage only at 14 gaging stations; stage and contents at 6 gaging stations and 2 other lakes and reservoirs; water quality at 19 observation wells. Also included are data for 59 crest-stage and 2 low-flow partial-record stations. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements. (USGS)
W84-03611

SEDIMENT DATA FOR MID-ARKANSAS AND UPPER-RED RIVER BASINS THROUGH 1980,
Geological Survey, Oklahoma City, OK. Water Resources Div.
S. P. Blumer.
USGS Open-File Report 83-692, 1983. 799 p, 4 Fig, 2 Tab.

Descriptors: *Fluvial sediment, *Suspended sediment concentration, *Water quality, *Sediment data, *Data collection, *Oklahoma, *Kansas, Red River, Arkansas River.

Sediment data have been collected at 279 locations within the Mid-Arkansas and Upper-Red basins in and along the borders of Oklahoma and Kansas. This compilation of sediment records presents tables and plots of all suspended-sediment data collected between 1930 and 1980. The publication not only provides a published source of all available suspended-sediment data, but more importantly provides potential users with an efficient means to access this large amount of data through the U.S. Geological Survey WATSTORE system. (USGS)
W84-03612

WATER RESOURCES DATA OREGON, WATER YEAR 1981: VOLUME 1. EASTERN OREGON.
Geological Survey, Portland, OR. Water Resources Div.
USGS Water-Data Report OR-81-1, 1983. 242 p, 5 Fig, 1 Tab.

Descriptors: *Oregon, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediment, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collection.

Water Resources Data for the 1981 water year for Oregon consists of records of stage, discharge, and water quality of stream; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality in wells and springs. This report, in two volumes, contains discharge records for 270 gaging stations; stage only records for 12 gaging stations; stage and contents for 44 lakes and reservoirs; water quality for 90 gaging stations, water levels for 66 observation wells; and water quality for 8 precipitation stations. Also included are 50 crest-stage partial-record stations. Additional water data were collected at various sites, not part of the systematic data collection program, and are published as miscellaneous measurements. (USGS)
W84-03613

WATER RESOURCES DATA OREGON, WATER YEAR 1981: VOLUME 2. WESTERN OREGON.
Geological Survey, Portland, OR. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83 229 492. USGS Water-Data Report OR-81-2, 1983. 509 p, 5 Fig, 1 Tab.

Descriptors: *Oregon, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediment, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collection.

Water Resources Data for the 1981 water year for Oregon consist of records of stage, discharge, and water quality of lakes and reservoirs; and water levels and water quality in wells and springs. This report, in two volumes, contains discharge records for 270 gaging stations; stage only records for 12 gaging stations; stage and contents for 44 lakes and reservoirs; water quality for 90 gaging stations, water levels for 66 observation wells; and water quality for 8 precipitation stations. Also included are 50 crest-stage partial-record stations. Additional water data were collected at various sites, not part of the systematic data collection program, and are published as miscellaneous measurements. (USGS)
W84-03614

WATER RESOURCES DATA HAWAII AND OTHER PACIFIC AREAS, WATER YEAR 1982: VOLUME 1. HAWAII,
Geological Survey, Honolulu, HI. Water Resources Div.
S. S. Chinn, G. A. Tateishi, and J. J. S. Yee.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84 122951. USGS Water-Data Report HI-82-1, 1983. 243 p, 14 Fig.

Descriptors: *Hawaii, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collection.

Water resources data for the 1982 water year for Hawaii and other Pacific Areas consist of records of stage, discharge, and water quality of streams and springs; and water levels and water quality in wells. This report, Volume 1, contains discharge records for 106 gaging stations; water quality for 11 gaging stations, 95 partial-record flow stations, and 152 wells; and water levels for 21 observations wells. Also included are 108 crest-stage partial-record stations and 15 low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data collection program, are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State, Federal, and other agencies in Hawaii. (USGS)
W84-03615

WATER RESOURCES DATA HAWAII AND OTHER PACIFIC AREAS, WATER YEAR 1982: VOLUME 2. GUAM, NORTHERN MARIANA ISLANDS, FEDERATED STATES OF MICRONESIA, PALAU, AND AMERICAN SAMOA,
Geological Survey, Honolulu, HI. Water Resources Div.
S. S. Chinn, G. A. Tateishi, and J. J. S. Yee.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84 122 944. USGS Water-Data Report HI-82-2, 1983. 146 p, 16 Fig.

Descriptors: *Pacific area, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Chemical analyses, Sediments, Reservoirs, Water temperatures, Sampling sites, Water levels, *Data collection.

Volume 2 of water resources data for the 1982 water year for other Pacific areas consist of records of stage, discharge, and water quality of streams and springs; stage of a lake and a reservoir; and water levels and water quality in wells. This report contains discharge records for 43 gaging stations; stage only records for 2 gaging stations; water quality for 1 gaging station, 36 partial-record stations; water temperature for 42 gaging stations; and water levels for 14 observation wells and water quality for 52 ground-water sites. Also included are 43 low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data collection program, and are published as miscellaneous measurements. These data represent that part of the national Water Data System operated by the U.S. Geological Survey and cooperating Governments and Federal agencies in other Pacific areas. (USGS)
W84-03616

WATER RESOURCES DATA NEW YORK, WATER YEAR 1983: VOLUME 1. EASTERN NEW YORK EXCLUDING LONG ISLAND,

Geological Survey, Albany, NY. Water Resources Div.
T. J. Zembrzuski, Jr., P. M. Burke, R. J. Archer, and J. A. Robideau.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84 114 198, USGS Water-Data Report NY-82-1, 1983. 267 p, 5 Fig, 1 Tab.

Descriptors: *New York, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Streamflow, Flow rates, Gaging stations, Lakes, Reservoirs, Chemical analysis, Sediments, Water analysis, Water temperature, Water levels, Water wells, *Data collections, Sites, Hudson River basin, Delaware River basin.

Water resources data for the 1982 water year for New York consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; quality of precipitation; and water levels of ground-water wells. This volume contains records for water discharge at 99 gaging stations; stage only at 5 gaging stations; and stage and contents at 4 gaging stations, and 19 other lakes and reservoirs; water quality at 25 gaging stations, 5 precipitation stations and water levels at 23 observation wells. Locations of these sites are shown on figures 4A and 4B. Also included are data for 51 crest-stage and 9 low-flow partial-record stations. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurement and analyses. (USGS)
W84-03617

WATER RESOURCES DATA NEBRASKA, WATER YEAR 1981.
Geological Survey, Lincoln, NE. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83 201 335. USGS Water-Data Report NE-81-1, 1982. 471 p, 6 Fig, 3 Tab.

Descriptors: *Nebraska, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water resources data for the 1981 water year for Nebraska consist of both surface water and ground water. This report contains water-discharge records for 163 streamflow gaging stations, 48 partial-record or miscellaneous streamflow stations, and 4 crest-stage, partial-record streamflow stations; stage and content records for 10 lakes and reservoirs; water-quality records for 55 streamflow stations, 36 ungaged stream-sites, and 154 wells; and water-level records for 59 observation wells. Additional water-discharge data were collected at various sites, not part of the systematic data-collection program, to determine surface-water/ground-water relationships and are published under low-flow investigations. (USGS)
W84-03618

WATER RESOURCES DATA COLORADO, WATER YEAR 1982: VOLUME 1. MISSOURI RIVER BASIN, ARKANSAS RIVER BASIN, AND RIO GRANDE BASIN,
Geological Survey, Lakewood, CO. Water Resources Div.
R. C. Ugland, J. T. Steinheimer, J. L. Blattner, and R. D. Steger.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84 128388. USGS Water Data Report CO-82-1, 1983. 403 p, 6 Fig, 5 Tab.

Descriptors: *Colorado, *Hydrologic data, *Surface water, *Groundwater, Water quality, Flow rate, Gaging stations, Lakes, Reservoir, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections, Missouri River basin, Arkansas River basin, Rio Grande basin.

Water-resources data for Colorado for the 1982 water year consists of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs, and water levels and water quality of wells and springs. This report (Volumes 1, 2, and 3) contains discharge records for 408 gaging stations, stage and contents of 27 lakes and reservoirs, 6 partial-record stations, and 50 miscellaneous sites; water levels for 55 observation wells. Nine pertinent stations in bordering States also are included in this report. The records were collected and computed by the Water Resources Division of the U.S. Geological Survey under the direction of J. F. Blakey, District Chief. (USGS)
W84-03619

WATER RESOURCES DATA COLORADO, WATER YEAR 1982: VOLUME 3. DOLORES RIVER BASIN, GREEN RIVER BASIN, AND SAN JUAN RIVER BASIN,
Geological Survey, Lakewood, CO. Water Resources Div.
J. T. Steinheimer, R. C. Ugland, H. E. Burch, and E. A. Wilson.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84 120 138. USGS Water Data Report CO-82-3, 1983. 366 p, 6 Fig, 5 Tab.

Descriptors: *Colorado, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections, Dolores River basin, Green River basin, San Juan River basin.

Water-resources data for Colorado for the 1982 water year consists of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs, and water levels and water quality of wells and springs. This report (Volumes 1, 2, and 3) contains discharge records for 408 gaging stations, stage and contents of 27 lakes and reservoirs, 6 partial-record low-flow stations, peak-flow information for 30 crest-stage partial-record stations, and 50 miscellaneous sites; water quality for 163 gaging stations and 245 miscellaneous sites; and water levels for 55 observation wells. Nine pertinent stations in bordering States are also included in this report. The records were collected and computed by the Water Resources Division of the U.S. Geological Survey under the direction of J. F. Blakey, District Chief. (USGS)
W84-03620

WATER RESOURCES DATA OHIO, WATER YEAR 1982: VOLUME 1. OHIO RIVER BASIN,
Geological Survey, Columbus, OH. Water Resources Div.
H. L. Shindel, L. L. Stewart, and J. R. Kolva.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83 229278. USGS Water-Data Report OH-82-1, 1983. 386 p, 3 Fig.

Descriptors: *Ohio, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rates, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperature, Sampling sites, Water levels, Water analyses, Streamflow, Water wells, Benthic fauna, *Data collections, Ohio River basin.

Water resources data for the 1982 water year for Ohio consist of records of stage, discharge, and water quality of streams; stage and contents, and water quality of lakes and reservoirs; and water levels and water quality of ground-water wells. This report in two volumes contains records for water discharge at 135 gaging stations; stage and contents at 39 lakes and reservoirs; water quality at 21 gaging stations and 92 wells; and water levels at 194 observation wells. Also included are data from 100 crest-stage partial-record stations; 118 low-flow partial-record stations, and 275 coal hydrology synoptic sites. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analyses. (USGS)
W84-03621

WATER RESOURCES DATA OHIO, WATER YEAR 1982: VOLUME 2. ST. LAWRENCE RIVER BASIN, STATEWIDE PROJECT DATA,
Geological Survey, Columbus, OH. Water Resources Div.
H. L. Shindel, L. L. Stewart, and J. R. Kolva.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83 229260. USGS Water-Data Report OH-82-2, 1983. 288 p, 3 Fig.

Descriptors: *Ohio, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rates, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperature, Sampling sites, Water levels, Water analyses, Streamflow, Water wells, Benthic fauna, *Data collections, St. Lawrence River basin.

Water resources data for the 1982 water year for Ohio consist of records of stage, discharge, and water quality of streams; stage and contents, and water quality of lakes and reservoirs; and water levels and water quality of ground-water wells. This report in two volumes contains records for water discharge at 135 gaging stations; stage and contents at 39 lakes and reservoirs; water quality at 21 gaging stations and 92 wells; and water levels at 194 observation wells. Also included are data from 100 crest-stage partial-record stations; 118 low-flow partial-record stations, and 275 coal hydrology synoptic sites. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analyses. (USGS)
W84-03622

WATER RESOURCES DATA SOUTH DAKOTA, WATER YEAR 1982,
Geological Survey, Huron, SD. Water Resources Div.
E. B. Hoffman, N. F. Leibbrand, D. R. Winter, and J. R. Little.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84 117175. USGS Water-Data Report SD-82-1, (1983). 298 p, 7 Fig, 3 Tab.

Descriptors: *South Dakota, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collection.

Water resources data for the 1982 water year for South Dakota consists of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels in wells. This report contains discharge records for 110 gaging stations; stage contents for 14 lakes and reservoirs; water quality for 32 gaging stations; and water levels for 8 observation wells. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements and analyses. (USGS)
W84-03623

WATER RESOURCES DATA NEVADA, WATER YEAR 1982,
Geological Survey, Carson City, NV. Water Resources Div.
H. R. Frisbie, R. J. LaCamera, M. M. Riek, and D. B. Wood.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84 120385. USGS Water-Data Report NU-82-1, (1983). 366 p, 9 Fig.

Descriptors: *Nevada, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling

sites, Water levels, Water analyses, *Data collection.

Water-resources data published herein for the 1982 water year comprise the following records: water discharge for 120 gaging stations on streams, canals, and drains; discharge data for 40 peak-flow stations and 5 low-flow stations on streams; stage and contents for 21 lakes and reservoirs; water levels for 229 observation wells; and water-quality data for 93 stream, canal, and drain sites, 13 lake and reservoir sites, and 2 wells. Additional water data, collected at various sites that are not part of the systematic data-collection program, are published as miscellaneous measurements. (USGS)
W84-03624

WATER RESOURCES DATA MICHIGAN, WATER YEAR 1982,
Geological Survey, Lansing, MI. Water Resources Div.
J. B. Miller, J. L. Oberg, and T. Sieger, Jr.
Available from the National Technical Information Service, Springfield, VA 22160, as PB83 229500. USGS Water-Data Report MI-82-1, 1983. 487 p, 9 Fig.

Descriptors: *Michigan, *Hydrologic data, *Surface water, *Ground water, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water resources data for the 1982 water year for Michigan consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water temperature of ground water. This report contains discharge records for 169 gaging stations; stage only records for 4 gaging stations; stage and contents for 5 lakes and reservoirs; water quality for 61 continuous-record stations; and water levels for 53 observation wells. Also included are 82 crest-stage partial-record stations and 44 low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. (USGS)
W84-03625

WATER RESOURCES DATA MISSISSIPPI, WATER YEAR 1981.
Geological Survey, Jackson, MS. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83 170746, USGS Water-Data Report MS-81-1, 1982. 410 p, 5 Fig.

Descriptors: *Mississippi, *Hydrologic data, *Surface water, *Ground water, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water analyses, *Data collection.

Water resources data for the 1981 water year for Mississippi consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground-water wells. This report contains records of water discharge at 82 gaging stations; stage records for 18 of these gaging stations; stage only at 4 gaging stations; contents for 4 lakes; water quality for 33 gaging stations, and 123 wells; and water levels for 324 observation wells. Also included are peak-discharge data for 91 crest-stage partial-record stations and water quality data for 18 partial-record or miscellaneous sites. Locations of these sites are shown on Figures 3-5. Additional water data were collected at various sites, not part of the systematic data collection program, and are published as miscellaneous measurements. (USGS)
W84-03626

WATER RESOURCES DATA MASSACHUSETTS AND RHODE ISLAND, WATER YEAR 1981.
Geological Survey, Boston, MA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83 201939. USGS Water-Data Report MA-RI-81-1, 1982. 281 p, 5 Fig, 1 Tab.

Descriptors: *Massachusetts, *Rhode Island, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collection.

Water-resources data for the 1981 water year for Massachusetts and Rhode Island consist of records of stage, discharge, and water quality of streams; contents of lakes and reservoirs; and ground-water levels. This report contains discharge records for 100 gaging stations, monthend contents for 30 lakes and reservoirs, water quality for 18 gaging stations, and water levels for 106 observation wells. Also included are data for 20 low-flow and 19 crest-stage partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. A few pertinent stations (not included above) in bordering States are also included in this report. (USGS)
W84-03627

WATER RESOURCES DATA IDAHO, WATER YEAR 1982: VOLUME 2. UPPER COLUMBIA RIVER BASIN AND SNAKE RIVER BASIN BELOW KING HILL,
Geological Survey, Boise, ID. Water Resources Div.
R. W. Harper, H. G. Sisco, I. O'Dell, and S. C. Cordes.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84 118488. USGS Water-Data Report ID-82-2, 1983. 292 p, 22 Fig.

Descriptors: *Idaho, *Hydrologic data, *Surface water, *Ground water, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collection, Upper Columbia River basin, Snake River basin.

Water resources data for the 1982 water year for Idaho consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground water. This report in two volumes contains discharge records for 192 gaging stations; stage only records for 2 gaging stations; stage only for 10 lakes and reservoirs; contents only for 11 lakes and reservoirs; water quality for 27 gaging stations, 38 partial-record stations, 143 wells; and water levels for 458 observation wells. Additional water data were collected at various sites, not involved in the systematic data collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Idaho. (USGS)
W84-03628

WATER RESOURCES DATA TEXAS, WATER YEAR 1981: VOLUME 1: ARKANSAS RIVER BASIN, RED RIVER BASIN, SABINE RIVER BASIN, NECHES RIVER BASIN, TRINITY RIVER BASIN AND INTERVENING COASTAL BASINS.
Geological Survey, Austin, TX. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83 158741, USGS Water Data Report TX-81-1, 1982. 597 p, 1 Fig.

Descriptors: *Texas, *Hydrologic data, *Surface water, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water analyses, *Data collection, Arkansas River basin, Red River basin, Sabine River basin, Neches River basin, Trinity River basin.

Surface-water data for the 1981 water year for Texas are presented in three volumes, appropriately identified as to content by river basins. Data in each volume consist of records of stage, discharge, and water quality of streams and canals; and stage, contents, and water quality of lakes and reservoirs. Also included are crest-stage and flood-hydrograph partial-record stations, reconnaissance partial-record stations, and low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. Records for a few pertinent stations in bordering States also are included. (USGS)
W84-03629

WATER RESOURCES DATA TEXAS, WATER YEAR 1981: VOLUME 2. SAN JACINTO RIVER BASIN, BRAZOS RIVER BASIN, SAN BERNARD RIVER BASIN, AND INTERVENING COASTAL BASINS.
Geological Survey, Austin, TX. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83 152017, USGS Water-Data Report TX-81-2, 1982. 511 p, 1 Fig.

Descriptors: *Texas, *Hydrologic data, *Surface water, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water analyses, *Data collection, San Jacinto River basin, Brazos River basin, San Bernard River basin.

Surface-water data for the 1981 water year for Texas are presented in three volumes, appropriately identified as to content by river basins. Data in each volume consist of records of stage, discharge, and water quality of streams and canals; and stage contents, and water quality of lakes and reservoirs. Also included are crest-stage and flood-hydrograph partial-record stations, reconnaissance partial-record stations, and low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. Records for a few pertinent stations in bordering States also are included. (USGS)
W84-03630

WATER RESOURCES DATA TEXAS, WATER YEAR 1981: VOLUME 3. COLORADO RIVER BASIN, LAVACA RIVER BASIN, GUADALUPE RIVER BASIN, NUECES RIVER BASIN, RIO GRANDE BASIN, AND INTERVENING COASTAL BASINS.
Geological Survey, Austin, TX. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83 152025. USGS Water-Data Report TX-81-3, 1982. 599 p, 1 Fig.

Descriptors: *Texas, *Hydrologic data, *Surface water, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water analyses, *Data collection, Colorado River basin, Lavaca River basin, Guadalupe River basin, Nueces River basin, Rio Grande River basin.

Surface-water data for the 1981 water year for Texas are presented in three volumes, appropriately identified as to content by river basins. Data in each volume consist of records of stage, discharge, and water quality of streams and canals; and stage, contents, and water quality of lakes and reservoirs. Also included are crest-stage and flood-hydrograph partial-record stations, reconnaissance partial-record stations, and low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. Records for a few pertinent stations in bordering States also are included. (USGS)
W84-03631

WATER RESOURCES DATA WYOMING, WATER YEAR 1982,
Geological Survey, Cheyenne, WY. Water Resources Div.
E. S. Denison, J. R. Schuetz, and S. J. Rucker, IV.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84 114669. USGS Water Data Report WY-82-1, (1983). 504 p, 4 Fig.

Descriptors: *Wyoming, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow-rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, Data collection.

Water resources data for the 1982 water year for Wyoming consists of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground water. This report contains discharge records for 185 gaging stations; stage only for records for 1 lake; stage and contents for 14 lakes and reservoirs; water quality for 85 gaging stations, and 61 ungaged stations; and water levels for 36 observation wells. Also included are 32 crest-stage partial-record stations and 1 precipitation monitoring site. Additional water data were collected at various sites, not part of the systematic data collection program, and are published as miscellaneous measurements. (USGS)
W84-03632

WATER RESOURCES DATA CALIFORNIA, WATER YEAR 1981: VOL. 1. COLORADO RIVER BASIN, SOUTHERN GREAT BASIN FROM MEXICAN BORDER TO MONO LAKE BASIN, AND PACIFIC SLOPE BASINS FROM TIJUANA RIVER TO SANTA MARIA RIVER.
Geological Survey, Sacramento, CA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83 174 466. USGS Water-Data Report CA-81-1, 1982. 417 p, 6 Fig.

Descriptors: *California, *Hydrologic data, *Surface water, *Water quality, *Groundwater, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediment, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collection.

Water-resources data for the 1981 water year for California consists of records of stage, discharge, and water quality of stream; stage and contents in lakes and reservoirs; and water levels and water quality in wells. Volume 1 contains discharge records for 169 gaging stations; stage and contents for 19 lakes and reservoirs; water quality for 42 streams and 21 wells; water levels for 169 observation wells. Also included are 10 crest-stage partial-record stations. (USGS)
W84-03633

WATER RESOURCES CALIFORNIA, WATER YEAR 1981: VOLUME 2. PACIFIC SLOPE BASINS FROM ARROYO GRANDE TO OREGON STATE LINE EXCEPT CENTRAL VALLEY.
Geological Survey, Sacramento, CA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83 174 474. USGS Water-Data Report CA-81-2, 1982. 513 p, 3 Fig.

Descriptors: *California, *Hydrologic data, *Surface water, *Water quality, *Groundwater, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediment, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water resources data in this volume for the 1981 water year consists of records of stage discharge, and water quality of streams and wells; stage, contents, and water quality in lakes and reservoirs; and water levels in wells. This report contains discharge records for 162 gaging stations; stage and contents for 12 lakes and reservoirs; water quality for 63 stations and 27 wells; water levels for 78 observation wells. Also included are 1 low-flow partial-record station and 32 water quality partial-record stations. (USGS)
W84-03634

WATER RESOURCES DATA CALIFORNIA, WATER YEAR 1981: VOL. 3. SOUTHERN CENTRAL VALLEY BASINS AND THE GREAT BASIN FROM WALKER RIVER TO TRUCKEE RIVER.
Geological Survey, Sacramento, CA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83 174 482. USGS Water-Data Report CA-81-3, 1982. 419 p, 12 Fig.

Descriptors: *California, *Hydrologic data, *Surface water, *Water quality, *Groundwater, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediment, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water resources data for the 1981 water year for California consists of records of stage, discharge, gage-height, and water quality of streams; stage, contents and water quality of lakes and reservoirs; water levels and water quality of wells. Volume 3 contains discharge records for 158 gaging stations; stage and contents for 50 lakes and reservoirs; gage height records for 2 lakes; water quality for 23 stations; water levels for 54 observation wells, and water quality for 7 wells. Also included are 11 crest-stage partial-record stations and two water-quality partial-record stations. (USGS)
W84-03635

WATER RESOURCES DATA CALIFORNIA, WATER YEAR 1981: VOLUME 4. NORTHERN CENTRAL VALLEY BASINS AND THE GREAT BASIN FROM HONEY LAKE BASIN TO OREGON STATE LINE.
Geological Survey, Sacramento, CA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83 174 458. USGS Water-Data Report CA-81-4, 1982. 359 p, 12 Fig.

Descriptors: *California, *Hydrologic data, *Surface water, *Water quality, *Groundwater, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediment, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water-resources data for the 1981 water year for California consists of records of stage, discharge, and water quality of streams; stage and contents in lakes and reservoirs; and water levels and water quality in wells. Volume 4 contains discharge records for 167 gaging stations; stage and contents for 26 lakes and reservoirs; precipitation data for 2 stations; water quality for 17 stations; water levels for 55 observation wells, and water quality for 18 wells. Also included are 4 crest-stage partial-record stations and 7 low-flow partial-record stations. Additional water data are collected at various sites, not part of the systematic data collection program, and are published as special investigations. (USGS)
W84-03636

WATER RESOURCES DATA IDAHO, WATER YEAR 1982: VOLUME 1. GREAT BASIN AND SNAKE RIVER BASIN ABOVE KING HILL,
Geological Survey, Boise, ID. Water Resources Div.
R. W. Harper, H. G. Sisco, I. O'Dell, and S. C. Cordes.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84 118 470. USGS Water-Data Report ID-82-1, 1983. 332 p, 12 Fig.

Descriptors: *Idaho, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collection, Smoke River basin, Great Basin.

Water resources data for the 1982 water year for Idaho consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground water. This report in two volumes contains discharge records for 192 gaging stations; stage only records for 2 gaging stations; stage only for 10 lakes and reservoirs; contents only for 11 lakes and reservoirs; water quality for 27 gaging stations, 38 partial-record stations, 143 wells; and water levels for 458 observation wells. Additional water data were collected at various sites, not involved in the systematic data collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Idaho. (USGS)
W84-03637

WATER RESOURCES DATA ALASKA, WATER YEAR 1982,
Geological Survey, Anchorage, AK. Water Resources Div.
R. D. Lamke, P. J. Still, B. B. Bigelow, H. R. Seitz, and J. E. Vaill.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84 119569. U.S.G.S. Water-Data Report AK-82-1, (1983). 363 p, 4 Fig.

Descriptors: *Alaska, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collection.

Water resources data for the 1982 water year for Alaska consists of records of stage, discharge, and water quality of streams; stage and water quality of lakes; and water levels and water quality in wells and springs. This report contains discharge records for 108 gaging stations; stage only record for 1 gaging station; water quality for 49 stations; and water levels for 28 observation wells. Also included are 43 low-flow, 67 crest-stage, and 48 water-quality partial-record stations. Additional water data were collected at various sites, not part of the systematic data collection program, and are published as miscellaneous measurements of discharge, lake stage, or water quality. (USGS)
W84-03638

WATER RESOURCES DATA WYOMING, WATER YEAR, 1981: VOLUME 1. MISSOURI RIVER BASIN.
Geological Survey, Cheyenne, WY. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83 170 944. USGS Water-Data Report WY-81-1, 1982. 575 p, 4 Fig.

Descriptors: *Wyoming, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow-rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water Temperatures, Sampling sites, Water levels, Water analyses, *Data collection.

Water resources data for the 1981 water year for Wyoming consists of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground water. Volume 1 of this report contains discharge records for 155 gaging stations; stage only for records for 1 lake, stage and contents for 11 lakes and reservoirs; water quality for 89 gaging stations, and 45 ungaged stations; and water levels for 33 observation wells. Also included are 75 crest-stage partial-record stations and 2 precipitation monitoring sites. Additional water data were collected at various sites, not part of the systematic data collection

program, and are published as miscellaneous measurements. (USGS)
W84-03639

WATER RESOURCES DATA WYOMING, WATER YEAR 1981: VOLUME 2. GREEN RIVER BASIN, BEAR RIVER BASIN, AND SNAKE RIVER BASIN.
Geological Survey, Cheyenne, WY. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83 170 951. USGS Water-Data Report WY 81-2, 1982. 219 p, 4 Fig.

Descriptors: *Wyoming, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow-rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collection.

Water resources data for the 1981 water year for Wyoming consists of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of wells. Volume 2 of this report contains discharge records for 62 gaging stations; stage and contents for 3 lakes and reservoirs; water quality for 30 gaging stations and 15 ungaged stations; and water levels for 7 observation wells. Also included are 24 crest-stage partial record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements and analyses. (USGS)
W84-03640

WATER RESOURCES DATA ILLINOIS, WATER YEAR 1982: VOLUME 1. ILLINOIS EXCEPT ILLINOIS RIVER BASIN,
Geological Survey, Urbana, IL. Water Resources Div.
R. L. Stahl, K. K. Fitzgerald, T. E. Richards, and P. D. Hayes.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84 120 112. USGS Water-Data Report IL-82-1, 1983. 496 p.

Descriptors: *Illinois, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collection.

Water resources data for the 1982 water year for Illinois consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels of groundwater wells. This volume contains records for water discharge at 92 gaging stations; stage at 17 gaging stations; stage and contents at 3 lakes and reservoirs, stage only at 1 lake station; and water quality at 117 gaging stations. Also included are data for 11 crest-stage partial-record stations. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analyses. These data together with the data in Volume 2 represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State, local, and Federal agencies in Illinois. (USGS)
W84-03641

WATER RESOURCES DATA ILLINOIS, WATER YEAR 1982: VOLUME 2. ILLINOIS RIVER BASIN,
Geological Survey, Urbana, IL. Water Resources Div.
T. E. Richards, P. D. Hayes, R. L. Stahl, and K. K. Fitzgerald.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84 120 120. USGS Water-Data Report IL-82-2, 1983. 401 p, 4 Fig.

Descriptors: *Illinois, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collection, *Illinois River basin.

Water resources data for the 1982 water year for Illinois consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels of groundwater wells. This volume contains records for water discharge at 83 gaging stations; stage only at 2 gaging stations; stage only at 3 lake stations; water quality at 96 gaging stations; and water levels at 3 observation wells. Also included are data for 18 crest-stage partial-record stations. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analyses. These data together with the data in Volume 1 represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State, local, and Federal agencies in Illinois. (USGS)
W84-03642

WATER RESOURCES DATA WEST VIRGINIA, WATER YEAR 1982,
Geological Survey, Charleston, WV. Water Resources Div.
W. N. Embree, E. A. Friel, T. A. Ehlke, and S. M. Ward.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84 120161. USGS Water-Data Report WV-82-1, (1983). 342 p, 5 Fig.

Descriptors: *West Virginia, *Hydrologic data, *Surface water, *Ground water, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collection.

Water resources data for the 1982 water year for West Virginia consist of records of stage, discharge, and water quality of streams and springs; stage and contents of lakes and reservoirs; and water levels in wells. This report contains discharge records for 116 gaging stations; stage only records for 9 gaging stations; stage and contents for 8 lakes and reservoirs; contents for 1 reservoir; change in contents for 1 reservoir; water quality for 55 gaging stations; and water levels for 29 observation wells. Also included are 2 crest-stage partial-record stations, and 1 low-flow partial record station. Additional water data were collected at various sites, not part of the systematic data collections program, and are published as miscellaneous measurements and analysis. (USGS)
W84-03643

WATER RESOURCES DATA NEVADA, WATER YEAR 1981.
Geological Survey, Carson City, NV. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83 229 310. USGS Water-Data Report NV-81-1, 1982. 404 p, 10 Fig.

Descriptors: *Nevada, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoir, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water-resources data published herein for the 1981 water year comprise the following records: water discharge for 132 gaging stations on streams, canals, and drains; discharge data for 82 peak-flow stations and 7 low-flow stations on streams; stage and contents for 21 lakes and reservoirs; water levels for 235 observation wells; and water-quality data for 106 stream, canal, and drain sites, 13 lake and reservoir sites, and 4 wells. Additional water data, collected at various sites that are not part of the systematic data-collection program, are published as miscellaneous measurements. (USGS)
W84-03644

WATER RESOURCES DATA NEW HAMPSHIRE AND VERMONT, WATER YEAR 1981.
Geological Survey, Boston, MA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83 229 310, USGS Water-Data Report NH-VT-81-1, 1982. 167 p, 4 Fig, 1 Tab.

Descriptors: *New Hampshire, *Vermont, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water-resources data for the 1981 water year for New Hampshire and Vermont consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels and water quality of wells. This report contains discharge records for 75 gaging stations, stage records for 3 lakes, monthend contents for 25 lakes and reservoirs, water-quality data for 4 gaging stations, and water levels for 30 observation wells. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. A few pertinent stations (not included above) in bordering States and Province of Quebec are also included in this report.
W84-03645

WATER RESOURCES DATA TENNESSEE, WATER YEAR 1982,
Geological Survey, Nashville, TN. Water Resources Div.
J. R. Lowery, P. H. Counts, H. L. Edmiston, and F. D. Edwards.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84 111 459. USGS Water-Data Report TN-82-1, (1983). 379 p, 6 Fig, 1 Tab.

Descriptors: *Tennessee, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediment analyses, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collection.

Water resources data for the 1982 water year for Tennessee consist of records of stage, discharge, and water quality of streams and springs; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of wells. This report contains discharge records for 112 gaging stations; stage only records for one lake gaging station; elevation and contents for 28 lakes and reservoirs; water quality for 70 stations and 77 wells; and water levels for 30 observation wells. Also included are 126 crest-stage partial-record stations and 23 low-flow partial-record stations. Additional water data were collected at various stream and spring sites not involved in the systematic data collection program and are published as miscellaneous measurements and analyses, or as seepage investigations of discharge and water quality. (USGS)
W84-03646

WATER RESOURCES DATA WISCONSIN, WATER YEAR 1982,
Geological Survey, Madison, WI. Water Resources Div.
B. K. Holmstrom, C. A. Harr, and R. M. Erickson.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84 243 915. USGS Water-Data Report WI-82-1, (April, 1983). 426 p, 5 Fig.

Descriptors: *Wisconsin, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collection.

Water-resources data for the 1982 water year for Wisconsin include records of stream-flow at gaging stations, partial-record stations, and miscel-

laneous sites, records of chemical, physical, and biological characteristics of surface water, ground water, and precipitation, and records of water levels in observation wells. Records for a few gaging stations in bordering states also are included. (USGS)
W84-03647

WATER RESOURCES DATA UTAH, WATER YEAR 1982,
Geological Survey, Salt Lake City, UT. Water Resources Div.
M. D. ReMillard, G. C. Anderson, E. Hookano, Jr., and G. W. Sandberg.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84 120 484. USGS Water-Data Report UT-82-1 (1983).

Descriptors: *Utah, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collection.

Water resources data for the 1982 water year for Utah consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels and water quality of ground water. This report contains discharge records for 233 gaging stations; stage and contents for 19 lakes and reservoirs; water quality for 45 hydrologic stations, and 185 wells; miscellaneous temperature measurements and field determinations for 167 stations; and water levels for 39 observation wells. Additional water data were collected at various sites not involved in the systematic data collection program, and are published as miscellaneous measurements. (USGS)
W84-03648

WATER RESOURCES DATA ARKANSAS, WATER YEAR 1981.
Geological Survey, Little Rock, AR. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83 201657. USGS Water-Data Report AR-81-1, 1982. 583 p, 5 Fig, 3 Tab.

Descriptors: *Arkansas, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collection.

Water resources data for the 1981 water year for Arkansas consist of records of gage height, discharge, and water quality of streams; elevation, contents, and water quality of lakes; water levels and water quality of observation wells. This report contains discharge records for 56 gaging stations; elevation and contents for 4 lakes, water quality for 160 gaging stations, 51 partial-record stations, 9 observation wells, 12 lakes; and water levels for 79 observation wells. Also included are 125 crest-stage partial record stations. Additional water data were collected at various sites, not part of the systematic data collection program, and are published as miscellaneous measurements. (USGS)
W84-03649

RECORDS OF WATER-LEVEL MEASUREMENTS AND LITHOLOGIC LOGS, RED RIVER VALLEY, LOUISIANA, 1975-80,
Geological Survey, Baton Rouge, LA. Water Resources Div.
C. W. Smoot.
Louisiana Department of Transportation and Development, Baton Rouge. Water Resources Basic Records Report No. 12, 1983. 197 p, 6 Fig, 18 Tab, 9 Ref.

Descriptors: *Alluvial aquifer, *Lithologic logs, *Water levels, Artesian wells, Water-table wells, Data collection, *Red River alluvial aquifer, *Louisiana, Terrace, Aquifer.

Navigation structures are planned for the Red River in Louisiana. Water levels measured in the Red River alluvial aquifer from January 1975 to December 1980 document preconstruction water-level fluctuations in wells in the aquifer. Water levels are recorded for 417 wells. In addition, lithologic logs for 124 wells or test holes are compiled to define the aquifer and confining bed. (USGS)
W84-03675

ADDENDUM TO THE SURFACE WATER QUALITY REPORT,
Disko (M.) Associates, Union, NJ.
For primary bibliographic entry see Field 5B.
W84-03678

GROUND-WATER RESOURCES IN THE CENTRAL PART OF THE FLATHEAD INDIAN RESERVATION, NORTHWESTERN MONTANA,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W84-03680

TECHNICAL MANUAL FOR ESTIMATING LOW-FLOW CHARACTERISTICS OF PENNSYLVANIA STREAMS,
Geological Survey, Harrisburg, PA. Water Resources Div.
H. N. Flippo, Jr.
Pennsylvania Department of Environmental Resources, Harrisburg, Water Resources Bulletin No. 15, October, 1982. 86 p, 2 Fig, 34 Tab, 15 Ref.

Descriptors: *Regional analysis, *Frequency analysis, *Regression analysis, *Low flow, Flow characteristics, Statistical models, *Pennsylvania, Delaware River basin, Susquehanna River basin, Ohio River basin, Potomac River basin, St. Lawrence River basin.

Regional regression equations are provided for estimation of annual low-flow discharges for 3-, 7-, 30-, and 120-day durations for recurrence intervals of 5, 10, 20, 50, and 100 years, respectively. Monthly regression equations, for six individual months of May through October, are provided for estimation of average minimum discharges for 1, 3, 7, and 30 days and the same recurrence intervals. These regression equations are applicable to most unregulated streams for which low-flow discharge records are unavailable. Drainage area, a geologic index, channel slope, and a precipitation index serve as independent variables in the regressions. Observed standard errors of regression are mostly in the range of 20 to 50 percent. This manual contains 15 references. (USGS)
W84-03688

GEOHYDROLOGY AND WATER USE IN SOUTHERN APACHE COUNTY, ARIZONA,
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 2F.
W84-03690

ESTIMATED IRRIGATION WATER USE IN FLORIDA, 1980,
Geological Survey, Tallahassee, FL. Water Resources Div.
R. M. Spechler.
Florida Bureau of Geology, Tallahassee, Map Series No. 106, 1983. 1 sheet map, 4 Fig, 1 Tab, 21 Ref.

Descriptors: *Water use, *Irrigation water, *Estimated use, *Florida, *Maps.

Estimated freshwater use in Florida averaged 7,309 million gallons per day in 1980. Approximately 41 percent, 2,997 million gallons per day, was withdrawn for irrigation of 2,041,400 acres. This is an increase of approximately 2,631 million gallons per day, more than eight times the amount used in 1950. About 1,574 million gallons per day, about 53 percent of the total, was from ground water. The remaining 1,423 million gallons per day came from surface-water sources. The largest use of water for irrigation was in central and southern Florida, where seven counties representing 56 percent of the irrigated land available for farming accounted for 60 percent of all irrigated water use during 1980. The smallest use of water for irrigation was in the northern part of the State, where 30 counties reported a combined water use of only 46 million gallons per day, or 2 percent of the water used for irrigation. Citrus is the major irrigated crop in the State, accounting for 30 percent of the total irrigated acreage. Pasture and sugarcane accounted for 24 and 23 percent, respectively. (USGS)
W84-03696

AVERAGE ANNUAL RAINFALL AND RUNOFF IN GEORGIA, 1941-70,
Geological Survey, Atlanta, GA. Water Resources Div.
R. F. Carter, and H. R. Stiles.
Georgia Department of Natural Resources, Atlanta, Hydrologic Atlas No. 9, 1983. 1 sheet map, 11 Ref.

Descriptors: Rainfall, *Runoff, Evapotranspiration, *Hydrologic cycle, Flow variability, *Georgia, *Maps, Rainfall maps, Runoff maps, Evaporation maps.

Maps showing average rainfall and runoff for the period 1941-70 for Georgia are presented. Annual rainfall averages 50 inches, runoff averages 15 inches, and evapotranspiration averages 35 inches. Average annual rainfall is as much as 76 inches in the northeast, but elsewhere is within about 10 percent of the statewide average of 50 inches. Annual average runoff is as much as 44 inches in the northeast and varies as much as 50 percent from the statewide average of 15 inches elsewhere. Runoff is different for each physiographic province, varying from 58 percent of the rainfall in the Blue Ridge province in the north to 24 percent of the rainfall in the Coastal Plain. Runoff also varies from year to year, but is more variable in the south than in the north. The standard deviation of the average annual runoff is as much as 67 percent of the mean for some stream gages in the south and is as little as 19 percent of the mean for some stream gages in the north. (USGS)
W84-03698

GUIDE TO THE LARVAE OF THE NEARCTIC DIAMESINAE (DIPTERA:CHIRONOMIDAE): THE GENERA BOREOHEPTAGYIA, PROTANYPUS, DIAMESA, AND PSEUDOKIEFFERIELLA,
Geological Survey, Doraville, GA. Water Resources Div.
J. S. Doughman.
Available from the Ofss, USGS, Lakewood, CO 80225, Price: $7.75 paper in copy, $3.50 in microfiche. USGS Water-Resources Investigations Report, 83-4006, 1983. 58 p, 40 Fig, 46 Ref.

Descriptors: *Aquatic insects, Taxonomy, Distribution, *Indices, Diptera, Chironomidae, Diamesinae, Larvae, Arctic, Alpine regions.

The subfamily Diamesinae consists of the monogeneric tribes Boreoheptagnini and Parotanypini and the diverse tribe Diamesini with seven genera. These midges are prevalent in clean, cool arctic-alpine waters, but less abundant in the lowlands. Keys and descriptions herein to the known species of these nine genera may prove valuable in the biomonitoring of these cool aquatic habitats. The larvae of Protanypus saetheri Wiederholm is described for the first time. Identification is based upon the absence of other species in the collection area. Examination of a series of larval D. incallida Walker collected in Wyoming and a review of pertinent literature shows that there is considerable variation in the procerus and the labral armature. Because these characters are often used in keys, this variability can lead to misidentification of less recognizable species of Diamesa. (USGS)
W84-03848

8. ENGINEERING WORKS

8A. Structures

COOLING WATER FACILITIES AT A NUCLEAR STATION,
Arizona Public Service Co., Phoenix.
W. L. Hurst, B. M. Ghadiali, and J. S. Kanovich.
Journal of Energy Engineering (ASCE), Vol. 109, No. 1, p 1-6, March, 1983. 3 Fig.

Descriptors: *Cooling water, *Nuclear powerplants, Cooling ponds, Wastewater facilities, Design criteria, Costs analysis, Comparison studies.

The use of ponds for holding a reserve of cooling water obtained as sewage effluent and also for collection of waste water for disposal by evaporation, was made at a nuclear power plant site in southern Arizona. The power output of the plant will be 3,900 MW. Two single cell ponds are 80 acres (30 ha) and 250 acres (100 ha) in size. Excavated materials from the 80-acre (30-ha) pond were used for structural backfill as planned, and the 250-acre (100-ha) pond was designed for limited dike height with balanced cut and fill and some excess materials used as side berms for additional safety. Both ponds are being lined with a unique combination of linings to provide environmental safeguards and at the same time cost-effectiveness is compared to alternative schemes. (Author's abstract)
W84-03712

UPLIFT PRESSURE IN CRACK BELOW DAM,
California Univ., Berkeley. Dept. of Civil Engineering.
R. E. Goodman, B. Amadei, and N. Sitar.
Journal of Energy Engineering (ASCE), Vol. 109, No. 4, p 207-221, December, 1983. 9 Fig, 2 Tab, 8 Ref.

Descriptors: *Uplift pressure, *Dams, *Cracks, Flow, Drains, Dam foundations, Drain spacing, Hydraulic head, Hydraulic models, Mathematical models.

A specific analytical solution for flow through a horizontal crack of finite length drained by a series of vertical drains is presented. The solution is used to derive diagrams of uplift pressure on the base of a dam and to demonstrate the influence of drains on the distribution and magnitude of uplift forces. Our solution shows that there should be an almost linear drop in hydraulic head from the entrance to the crack at the heel of the dam to the line of drains, followed by a slight rise in head to the end of the crack. This is consistent with a previosly suggested solution for porous media. The results show that drain holes are effective in substantially reducing uplift pressures in a crack and have the greatest influence when located between approximately one half and one fifth of the length of the crack from its upstream end. (Author's abstract)
W84-03715

MAIN DIRECTIONS IN EFFICIENT DAM CONSTRUCTION IN THE NORTH,
For primary bibliographic entry see Field 8D.
W84-03765

PROVISION OF RELIABILITY OF EARTH DAMS,
For primary bibliographic entry see Field 8D.
W84-03766

HIGH-HEAD REGULATING DIAPHRAGM-GATE,
L. L. Dol'nikov, S. V. Seleznev, and N. V. Shragin.
Hydrotechnical Construction, Vol. 17, No. 8, p 435-438, August, 1983. 4 Fig, 3 Ref. Translated from Gidrotekhnickeskoe Stroitel'stvo, No. 8, p 37-39, August, 1983.

Descriptors: *Gates, *Spillways, *Construction, Design criteria, Diaphragm gates, Hydroelectric plants, Powerplants, Reservoirs.

The cost of high-head hydrostations can be substantially reduced by combining the temporary and operating spillways, but difficulties arise due to the need to close the large openings at a full head after filling the reservoir. Design studies and experimental investigations were conducted to evaluate the prospects of using a diaphragm-gate as the main gate of a deep high-head spillway at a head of 100-200 m and discharge of 500-2000 cubic m/sec. Advantages of the diaphragm gate as opposed to the radial gate include the possibility of rapid reconstuction of the orifice for reducing its area. The use of the diaphragm gate is especially effective where it makes it possible to eliminate the construction of a second level of the spillway and to convert the temporary spillway into an operating spillway. During permanent operation the diaphragm can be sealed off and thereby expenses on repair of the seals can be eliminated and the reliability of the gate chamber increased. The possibility of closing large orifices by this gate makes it promising when developing the hydropower resources of the large rivers of Siberia and the Far East. (Baker-IVI)
W84-03913

USE OF ROCK ANCHORS TO HEIGHTEN A CONCRETE DAM.
International Water Power and Dam Construction, p 36, March, 1984. 3 Fig.

Descriptors: *Dam construction, *Anchors, Reservoirs, Storage reservoirs, Concrete dams, Sebakwe Dam, Zimbabwe.

Increasing storage capacity of a reservoir by raising the height of its retaining dam can be an effective way of meeting increased requirements for water or energy. Sebakwe Dam is the largest dam in the midlands of Zimbabwe. The optimal method of increasing the supply of water to this area would be by raising the height of the dam by an effective 6 m, doubling its storage capacity and thereby increasing its yield. Rock anchors were set vertically and positioned about 1 to 2 m from the upstream face of the dam. The nine central spillway blocks have two anchors each, while the non-overflow blocks on each flank generally have four or five each. Construction began on the $13.5 million contract in June 1982 and is expected to be completed by early 1985. (Baker-IVI)
W84-04080

8B. Hydraulics

UPLIFT PRESSURE IN CRACK BELOW DAM,
California Univ., Berkeley. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8A.
W84-03715

FORMATION AND EFFECTS OF ALTERNATE BARS,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
M. N. R. Jaeggi.
Journal of Hydraulic Engineering, Vol. 110, No. 2, p 142-156, February, 1984. 7 Fig, 38 Ref, 1 Append.

Descriptors: *Alternate bars, *Bar formation, *River flow, River regulation, Velocity, Bed load, Scour, Slope, Grain size, Channel morphology, Armoring, Flow resistance, Equations, Sediment transport, Flow resistance.

Major river regulation works have often resulted in alternate bar formation. Experimental work is described which provides more information on this phenomenon. Alternate bar formation is closely associated with meandering, inferring that alternate bar formation is caused by flow induced periodic disturbances of the horizontal velocity profile. Based on these considerations a criterion has been developed which defined the upper limit of alternate bar formation, and this has been satisfactorily compared to other formation criteria and experimental data. The lower limit is given by the initiation of bedload transport. A simple relation between slope, channel width and grain size is then deduced to indicate whether for a given channel, alternate bars can develop for any discharge. This relation takes into account armoring effects. Another equation is proposed to predict the scour depth resulting from alternate bar formation. Such scour often induces costly river maintenance works. Finally, some interesting results of flow resistance have been found, leading to a tentative equation for the intermediate roughness range. (Author's abstract)
W84-03719

MODELING OF RIVER CHANNEL CHANGES,
H. H. Chang.
Journal of Hydraulic Engineering, Vol. 110, No. 2, p 157-172, February, 1984. 10 Fig, 17 Ref, 1 Append.

Descriptors: *Channels, *Mathematical models, *Model studies, *River beds, Simulation, Flood routing, Sediment routing, Bed profile, Power expenditure, Sediment transport.

A computer-based flood- and sediment-routing model which simulates river channel changes is described together with its application in the case study of a disturbed river. Simulation results of this study are supported by field observations and measurements. This model incorporates the interrelated changes in channel bed profile, width, and lateral migration in channel bends. These changes reflect, in part, a river's adjustments in power expenditure. The interrelation of changes in channel bed profile and width is illustrated by a physical example and explained by the river's tendency to establish equal power expenditure along the channel. Such power transformation associated with river channel evolution tends to restore the dynamic equilibrium in sediment transport, that is, equal sediment load along the channel. The case study demonstrates that in the case of severely disturbed rivers, flood-level computation using a fixed-bed model may be quite inaccurate and improved accuracy can be provided by an erodible-bed model. (Author's abstract)
W84-03720

CELLULAR SECONDARY CURRENTS IN STRAIGHT CONDUIT,
Kyoto Univ. (Japan). Dept. of Civil Engineering.
I. Nezu, and H. Nakagawa.
Journal of Hydraulic Engineering (ASCE), Vol. 110, No. 2, p 173-193, February, 1984. 20 Fig, 1 Tab, 19 Ref.

Descriptors: *Hydraulic engineering, *Flow pattern, *Conduits, Sedimentation, *Water currents, Flow, Open-channel flow, River beds.

Cellular secondary currents are important in hydraulic engineering because these currents might cause three-dimensional sediment distributions and bedforms in a straight river. An investigation was made of the structure of cellular secondary currents in air conduit flow because the turbulent measurements of air flow by hot wires are much easier and much more accurate than those of water flow by hot films. Considering an essential interaction between secondary currents and bedform, longitudinal ridge elements were attached onto both lower and upper bottoms of the conduit, which simulated the longitudinal ridges and trough of river bedform. All three components of the velocity were measured accurately by hot-wire anemometers. The structure of secondary currents was examined through the equations of mean flow vorticity and mean flow energy. When the spanwise spacing of the ridges is set equally to that of the sand ribbons in a river, cellular secondary currents similar to those of open channel are reproduce fairly well in air conduit, although the intensity of these currents is somewhat depressed near the symmetrical plane due to the absence of free surface. The Reynolds stress term is nearly balanced with the production term of vorticity in most of the cell structure. A closed region of low pressure occurs over the ridges where the intense upflow is produced. This feature is consistent with that of

kolk-vortex and tornado motion in geophysical flows. (Baker-IVI)
W84-03721

OPTIMAL CONTROL PROBLEMS IN TIDAL POWER,
Reading Univ. (England). Dept. of Mathematics.
N. Birkett, B. M. Count, and N. K. Nichols.
International Water Power and Dam Construction, Vol. 36, No. 1, p 37-42, January, 1984. 6 Fig, 1 Tab, 9 Ref.

Descriptors: *Tidal powerplants, *Optimization, Systems analysis, Powerplants, Estuaries, Tidal estuaries, Water resources development, Planning, Decision making, Severn Barrage, England.

There have been a number of studies to investigate the feasibility of using the tidal energy in the Severn Estuary to produce electricity. The most recent study concludes that a Severn Barrage is technically feasible, and could be economically attractive. The economic arguments have been hotly debated; in such evaluations both the component costs and energy produced must be determined accurately and this has posed a complex optimization problem. A theory for optimal control that has general application to problems in tidal power has been developed which incorporates the estuarine dynamics into the optimization. Optimized performance of two-way generation schemes could be superior to that of ebb generation, although the efficiency loss of the turbines designed for reverse operation has not been taken into consideration. (Baker-IVI)
W84-03726

INVESTIGATING ASYMMETRIC FLOWS,
Benin Univ., Benin City (Nigeria). Faculty of Engineering.
L. A. Salami.
International Water Power and Dam Construction, Vol. 36, No. 1, p 46-57, January, 1984. 6 Fig, 4 Tab, 4 Ref.

Descriptors: *Fluid mechanics, *Flow, Velocity profiles, Computers, Velocity, Statistical analysis, Mathematical studies.

Areas of asymmetric flow measurement which are difficult to study experimentally have been explored using theoretical velocity profiles and computer programs. A statistical analysis was used to decide which of the various velocity-area methods is best based on the result of 23 theoretical profiles developed and the problems of their practical application. The same method was used to investigate the best arrangement of points to traverse an asymmetric flow. The velocity-area methods studied include AMCA, cubic, log-linear, log-Tchebycheff and log-cubic. The most important parameter in traversing an asymmetric flow is the spread of radii used for traversing, i. e. the array of radii. The optimum is six radii. Of lesser importance is the number of traverse points, provided it is more than four, and the velocity-area method, provided one of the five assessed in this investigation is used. The log-Tchebycheff method had a slight edge over other methods. Errors from mispositioning can be quite large, and increasing the number of traverse points per radius did not necessarily reduce the error. Traversing along a diameter gives a much better result than along a radius but this conclusion may depend on experimental conditions. (Baker-IVI)
W84-03728

STABILITY OF CHANNELS OF LARGE CANALS ON LARGE-SCALE ERODIBLE MODELS,
A. M. Mukhamedov, T. Zh. Zhuraev, and Kh. Kh. Ishanov.
Hydrotechnical Construction, Vol. 17, No. 8, p 405-410, August, 1983. 3 Fig, 2 Tab, 9 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 8, p 21-23, August, 1983.

Descriptors: *Channel erosion, *Model studies, *Stability, *Canals, Construction, Design criteria, Erosion control, Channels, Soil properties, Flow velocity.

The design of large canals requires an examination of numerous problems, including the determination of optimal average noneroding velocity of the flow for cohesionless soils of the canal bed; establishment of the most advantageous channel form parameter for which transverse and longitudinal deformation of the canal is precluded; the selection of the roughness coefficient for large canals whose channel is composed of sand and subjected to local deformations. Experimental findings suggest the deformation of sand canals to a considerable extent is determined by the initial form of the channel and hydraulic elements. Deformation of sand canals with specified initial elements and with a particular relative roughness of the channel on the model occurs quite slowly, with stabilization of the stream gradient. The average depths and values of the Froude and Reynolds numbers hardly change during the observed deformations of the investigated channels. During channel deformation small changes in the bottom relief and kinematic structure of the flow are noted and redistribution of the fractional composition of the soil with subsequent stabilization of all elements of the flow and channel is observed. (Baker-IVI)
W84-03909

HYDRODYNAMIC LOADS AND STABILITY OF THE LOWER-POOL APRON OF HYDRAULIC STRUCTURES,
O. N. Chernykh, and L. V. Komel'kov.
Hydrotechnical Construction, Vol. 17, No. 8, p 410-416, August, 1983. 6 Fig, 5 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 8, p 24-28, August, 1983.

Descriptors: *Hydraulic structures, *Design criteria, *Aprons, Conduits, Hydrodynamics, Stability, Reynolds number.

The main types of structures on reclamation systems are closed conduit offtake regulators and transitions. Weirs with pipe outlets are also being constructed for creating reservoirs and ponds. The structures of the lower pool are often insufficiently reliable, and cases of deformation of the baffle platform and destruction of the lining within the limits of the apron are common. Theoretical and experimental investigations have been performed to determine the characteristics of the dynamic effect of flow on protective elements associated with the lower pool apron of hydraulic structures beyond the energy dissipators and to evaluate the stability of the protective platforms and the water saturated foundation under them. The experiments were conducted on devices providing values of Reynolds numbers in the lower pool from 20,000 to 75,000. The proposed designs of the protective cover of the lower pool resulting from these studies in expanding channels, the method of determining the loads on its elements, and the developed method of estimating the stability of the cover are being used in the design of a number of reclamation structures. (Baker-IVI)
W84-03910

CALCULATION OF THE PROTECTIVE FACING OF SLOPES OF HYDRAULIC STRUCTURES WITH CONSIDERATION OF WIND-WAVE REFRACTION,
M. E. Plakida.
Hydrotechnical Construction, Vol. 18, No. 8, p 429-432, August, 1983. 3 Fig, 1 Tab, 5 Ref. Translated from Gidrotehknicheskoe Stroitel'stvo, No. 8, p 34-36, August, 1983.

Descriptors: *Shore protection, *Waves, *Hydraulic structures, *Erosion control, Erosion, Wind, Shores, Reservoirs, Rockfill structures, Model studies.

Consideration of refraction of waves during their oblique approach to a slope-type structure compared to the frontal approach of waves makes it possible to lighten the protective revetment of the slope from the damaging action of waves. This is achieved by the fact that the impact of a wave when it breaks on a slope is dispersed in time and space, and also the run-up of the wave on the slope of the structure. Laboratory investigations to evaluate the oblique approach of waves to a rockfill slope, despite their limitedness (small scale of the model or investigation only at one gradient of the slope, equal to 1.5), show the economic expediency of taking into consideration wave refraction in such cases. Equations are derived which are recommended for calculating refraction and the mass of stone for protecting slopes from waves in the case of their oblique approach. (Baker-IVI)
W84-03911

PROVISION OF RELIABILITY OF SURPLUSING AND OUTLET WORKS OF LARGE HYDROELECTRIC SCHEMES,
L. D. Lentyaev, and L. V. Smirnov.
Hydrotechnical Construction, Vol. 17, No. 8, p 439-442, August, 1983. 3 Fig, 5 Ref. Translated from Gidrotechnicheskoe Stroitel'stvo, No. 8, p 40-41, August, 1983.

Descriptors: *Spillways, *Floods, *Erosion control, *Reliability, Cavitation, Hydraulic structures, Design criteria, Prediction.

During its planned service life, a spillway should guarantee to a certain degree of reliability the passage of flood discharges without the creation of an emergency situation for other structures which are part of the same hydroelectric scheme. To ensure this, the discharge of water must first be determined as well as the time when larger discharges are likely to occur in the period of the guaranteed, no-failure operation of the spillway. Attention must be given to erosion in the lower pool, to hydrodynamic loads on elements of the spillway passage, and to the cavitation phenomenon. (Baker-IVI)
W84-03914

INCREASE OF ELECTRIC POWER PRODUCTION AT THE KHRAMI-I HYDROELECTRIC STATION BY RETURN OF RESERVOIR SEEPAGE WATER,
V. M. Nasberg.
Hydrotechnical Construction, Vol. 11, No. 8, p 443-447, August, 1983. 5 Ref. Translated from Gidrotekhnickeskoe Stroitel'stvo, No. 8, p 54-56, August, 1983.

Descriptors: *Pumping, *Reservoir, *Seepage, *Khrami Hydrostation, Hydroelectric plants, Powerplants, Energy.

Studies conducted at the Khrami-I hydrostation indicate that pumping of water being lost due to seepage from the reservoir with return of this water to it will make it possible to increase electric power production by 17% with a payback period of the investments in the structures for pumping of less than the standard. Pumping will be from the lower level with a discharge equal to or greater than the discharge of all seepage water with return of the pumped water to the reservoir or diversion tunnel. The water being pumped should be stored in the reservoir not longer than 5-10 days, using it as needed for covering the peaks of the daily and weakly load curve of the power system. On converting the reservoir operating regime to the design regime it is best to control production loses due to seepage by a combined method consisting of cutoff measures on the reservoir banks with pumping of all seepage water into the diversion tunnel or reservoir. Cutoff measures in the floodplain part of the reservoir are difficult to accomplish and insufficiently long-lived. Groundwater pumping can be used for increasing the production of energy by other mountain hydrostations as well. (Baker-IVI)
W84-03915

DESIGN OF ENERGY-EFFICIENT PIPE-SIZE EXPANSION,
Manitoba Univ., Winnipeg. Dept. of Agricultural Engineering.
G. E. Laliberte, M. N. Shearer, and M. J. English.
Journal of Irrigation and Drainage Engineering, Vol. 109, No. 1, p 13-28, March, 1983. 1 Fig, 3 Tab, 16 Ref, 1 Append.

Descriptors: *Fluid flow, *Design criteria, *Energy, *Pipe size, Pipe flow, Water conveyance, Design flow, Optimization, Energy loss.

Fluid flow is analyzed through a two-stage conical diffuser used to reduce the velocity of pipe flow. An analytical approach is described for determining the optimum diameter at the interface between the first stage, a conical diffuser, and the second stage, an abrupt enlargement, such that, for given approach and exit diameters and for a given diffuser length, the energy loss coefficient is the lowest possible. Over a practical range of diameter and length ratios (ratios of exit diameter and diffuser length, respectively, to approach diameter), the analysis demonstrates that the optimal internal planar angle varies from 5 degrees 47' to 17 degrees 11' (0.101 rad-0.300 rad), and the energy loss coefficient to be applied to the approach velocity head varies from 0.01-0.25. The energy loss coefficients for the optimally designed two-stage conical diffuser are considerably less than for a single-stage diffuser and for an abrupt enlargement. Equations are presented showing the interrelationship among coefficients used variously to express energy loss in a pipe-diameter expansion as a function of approach and exit velocities. The results are presented in a form that can be used as design criteria in the fabrication of a comparison fitting for centrifugal pumps. (Murphy-IVI)
W84-04035

MEASUREMENT DEVICE EFFECT ON CHANNEL WATER LOSS,
Agricultural Research Service, Kimberly, ID. Snake River Conservation Research Center.
T. J. Trout.
Journal of Irrigation and Drainage Engineering, Vol. 109, No. 1, p 60-71, March, 1983. 7 Fig, 2 Tab, 11 Ref, 1 Append.

Descriptors: *Water loss, *Measuring instruments, Inflow-outflow analysis, Mathematical studies, Channels, Regression analysis, Head loss.

Flow measurement devices can cause significant errors in inflow-outflow channel water loss measurements. The device effects, caused by the increased water surface elevation upstream of a device, must be subtracted from measured losses to correctly estimate conveyance water loss. Methods to calculate device effects are given. In channels with small slopes and in which loss rates increase sharply with water surface increases, inflow-outflow loss measurements should be made in long channel sections with devices which create as little head loss as possible. (Author's abstract)
W84-04038

PREDICTION OF PEAK FLOWS ON SMALL WATERSHEDS IN OREGON FOR USE IN CULVERT DESIGN,
Pacific Northwest Forest and Range Experiment Station, Juneau, AK. Forestry Sciences Lab.
For primary bibliographic entry see Field 2E.
W84-04098

WASTE INJECTION: TESTING FOR MECHANICAL INTEGRITY,
Louisiana State Univ., Baton Rouge. Dept. of Petroleum Engineering.
T. C. Wilcox, and J. P. Langlinais.
Water Resources Bulletin, Vol. 20, No. 1, p 53-60, February, 1984. 7 Fig, 1 Tab, 8 Ref.

Descriptors: *Injection wells, *Underground waste disposal, *Mechanical integrity, Annular pressure, Temperature, Wastewater.

A generally accepted method to show mechanical integrity of waste injection wells is to monitor hydraulic pressure applied to the closed fluid filled annular volume (the space between the casing and tubing of an injection well). Injection pressure and waste stream temperature changes are very common, however, and these changes are reflected in annular pressure changes. Results of computer calculations are presented which predict the pressure response of a closed casing annulus of an injection well to temperature and pressure variations of the injected waste stream. The changes in injection pressure proved to be less significant than changes in the temperature of the injected fluid. Changes in injection pressure induce stress changes in the tubing and casing. The annular space undergoes a volumetric change which is reflected as a surface annular pressure change. Temperature variations of the waste stream will generate significant volumetric changes in the annular fluid which in turn results in changes in annular pressure. Graphs summarizing these results are included. Results will be of interest to waste injection well operators, inasmuch as they are required to monitor annular pressure to prove mechanical integrity of their injection wells. In view of the injection pressure and sensitive temperature effects, a constant annular pressure during routine injection operations is highly unlikely. Operators must be aware of the magnitude of these effects. (Moore-IVI)
W84-04104

8C. Hydraulic Machinery

SOLVING A SEVERE CAVITATION PROBLEM AT LA GRANDE 2,
Rousseau, Sauve, Warren, Inc., Montreal (Quebec).
D. M. Coulson, A. Demers, N. Desy, and J. G. Miron.
International Water Power and Dam Construction, Vol. 36, No. 1, p 20-24, January 1984. 9 Fig, 1 Tab, 4 Ref.

Descriptors: *Cavitation, *Turbines, *Canada, *La Grande Hydroelectric Plant, Powerplants, Hydraulic engineering, Hydraulic equipment.

A severe cavitation problem was discovered three thousand hours after the commissioning of the first unit at La Grande 2. A series of model tests was undertaken to arrive as quickly as possible at a solution. Several months of testing resulted in the conclusion that modern hydraulic turbine runners such as those supplied for LG-2 are very advanced from the points of view of power and efficiency and are more susceptible to blade entrance cavitation than less advanced runner designs. This type of cavitation is only slightly affected by the normal range of turbine setting. The experience gained at LG-2 has demonstrated that for all large projects, it is justifiable to undertake analytical and model test studies during the hydraulic design, of sufficient depth to ensure that the flow conditions in the normal operating range do not give rise to inlet edge cavitation. (Baker-IVI)
W84-03725

TRANSIENTS AND UNSTEADY PHENOMENA TO IMPROVE THE DESIGNS OF HYDROELECTRIC, PUMPED-STORAGE, AND PUMPING STATIONS,
V. Ya. Karelin, G. I. Krivchenko, N. N. Arshenevskii, and R. A. Novoderezhkin.
Hydrotechnical Construction, Vol. 17, No. 8, p 389-395, August, 1983. 4 Fig, 7 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 8, p 8-11, August, 1983.

Descriptors: *Pumped storage, *Pumping stations, *Optimization, *Design criteria, Computers, Powerplants, Construction, Hydroelectric plants, Automation, Costs.

The problems of designing technological regimes to regulate the pumped storage units at hydroelectric stations include the selection of the optimal schemes, dimensions of the pressure conduits, parameters of the units and automatic control systems while considering all technical and economic factors, such as the reliability of operation, the required qualitative indices, and maximum cost effectiveness. One way to reduce the volume of works and capital investments in hydropower installations is to increase the response of pressure systems. Consideration of the real operating conditions and requirements is an important factor in the optimization of the designs of structures and equipment. Further developments in recommendations for optimization of the regimes of regulating units and also the introduction of numerical methods with consideration of the complete characteristics of the units with the use of computers are described. Additional improvement is needed in the computer calculation programs, particularly in optimizing the calculation methods ensuring an increase in reliability and stability of the solution. (Baker-IVI)
W84-03908

MICRO HYDRO: TURBINE SELECTION CRITERIA,
Papua New Guinea Univ. of Technology, Lae. Dept. of Mechanical Engineering.
R. J. Hothersall.
International Water Power and Dam Construction, p 26-29, February, 1984. 2 Fig, 2 Tab, 11 Ref.

Descriptors: *Pumps, *Turbines, *Decision making, *Hydroelectric plants, Mechanical equipment, Powerplants, Water resources development, Developing countries.

The term micro hydro refers to all the equipment and civil works necessary to exploit a hydropower resource of less than 100 kW. In developing countries, micro hydro often provides the only feasible energy source. A method is presented by which, for a given small hydropower resource, a suitable turbine or pump can be selected. Design features specific to small turbines are also presented. In certain applications a pump, operating in reverse as a turbine, provides an acceptable option. Data for pump selection are included. Advantages and disadvantages of impulse and reaction turbines are considered. A selection chart is offered for water turbines under 100 kW. (Baker-IVI)
W84-04075

EXPLOITING IRRIGATION SYSTEMS WITH HYDROPOWER,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Mechanical, Industrial and Aerospace Engineering.
R. R. Mankbadi, S. Mikhail, and A. Baz.
International Water Power and Dam Construction, p 29-33, February, 1984. 11 Fig, 3 Ref.

Descriptors: *Turbines, *Irrigation, *Pumps, Mechanical equipment, Design criteria, Water resources development, Planning, Low head.

The turbine-pump system installed across irrigation structures in which the available low head energy is used to drive a turbine connected to a pump to lift water for irrigation or domestic purposes is examined. The equations governing the operation of the system are considered. A model is presented for determining the main design parameters of the system for a given regulator's characteristics. A method is outlined to determine the turbine's rotor and the guide blades setting such that the unit is pumping the maximum possible discharge. This procedure is applied to an example of a turbine-pump network system. The system can be designed to pump the maximum possible amount of flow at design as well as off-design conditions. The system should be considered whenever water pumping is needed for irrigation purposes or water supply and where low head hydro is available. (Baker-IVI)
W84-04076

GENERATOR DESIGN FOR SMALL HYDRO APPLICATIONS,
GEC Large Machines Ltd., Rugby (England).
F. J. Parker.
International Water Power and Dam Construction, p 55-57, February, 1984. 3 Fig.

Descriptors: *Generators, *Design criteria, Powerplants, Hydroelectric plants, Maintenance, Mechanical equipment.

Generators for small hydro schemes in the range of 500 kW to 5 MW must satisfy a number of criteria which range from the ability to withstand high overspeeds to ease of maintenance. The inertia requirements are met by the provision of a flywheel which may be located in a variety of posi-

tions. To withstand the overspeeds, the laminated components of the rotor must be of a high tensile strength material. Bearings must be able to absorb axial and radial thrusts generated by the turbine without overheating. To increase reliabiltiy, comprehensive instrumentation is supplied. (Baker-IVI)
W84-04077

AUTOMATIC HYDRAULIC GATES FOR INTAKE STRUCTURES,
Energy Engineering International, Munich (Germany, F.R.).
M. K. Jermar.
International Water Power and Dam Construction, p 57-59, February, 1984. 1 Fig, 3 Ref.

Descriptors: *Gates, *Hydraulic structures, *Hydraulic gates, Dam construction, Developing countries, Design criteria.

The automatic operation of gates for intake structures should be achieved by simple technology based on hydraulic principles only and requiring neither gearing and lifting machinery nor construction of a power supply line. A gate is suggested which consists of a hollow body with the swing axes on the weir sill. This body acts as a float balancing the weight of the gate. Its automatic operation during floods could be achieved simply by connecting a wing to the wicket. There is no danger that their resting in the upper position will cause inundation because the hydraulic pressure causes the wicket to swing downwards. The advantage is a simple construction with high structural solidity, able to be fabricated from locally available materials. Such systems are specially suitable for the conditions of remote areas in developing countries. (Baker-IVI)
W84-04078

PERFORMANCE OF STATIONARY GUN IRRIGATION SYSTEMS,
British Columbia Univ., Vancouver. Dept. of Civil Engineering.
B. W. Karney, and T. H. Podmore.
Journal of Irrigation and Drainage Engineering, Vol. 110, No. 1, p 75-87, March, 1984. 3 Fig, 1 Tab, 12 Ref.

Descriptors: *Giant gun irrigation systems, *Stationary irrigation, Application rate, Evaporation, Spray loss, Wind.

The field performance of stationary giant gun irrigation systems is evaluated from the results of 70 distribution tests conducted in the interior of British Columbia, Canada. Three measures of field performance are quantitatively evaluated including maximum application rate, evaporation and spray loss and distribution uniformity. Maximum application rate is found to be a function of average wind speed in the principal wind direction. Evaporation and spray losses were dependent on climatic and operating conditions, primarily the atmospheric vapor density deficit and the average wind speed. The uniformity of application is strongly influenced by both the gun spacing and the average wind speed. The influence of operating variables such as nozzle size and pressure are accounted for in the parameters used to nondimensionalize these relationships. The equations representing these findings are derived using multiple regression and are presented algebraically. Measured values are plotted against predicted values to give a visual impression of scatter in the data. The utility of the relationships in designing and operating giant gun systems is illustrated. (Author's abstract)
W84-04095

HYDRAULICS OF PERFORATED IRRIGATION TRAIL TUBE,
South Dakota State Univ., Brookings.
S. T. Chu.
Journal of Irrigation and Drainage Engineering, Vol. 110, No. 1, p 88-97, March, 1984. 5 Fig, 7 Ref, 2 Append.

Descriptors: *Trailing tubes, *Irrigation, *Hydraulics, Flow rate distribution, Friction loss, Pressure distribution.

Trailing tubes are perforated polyflex hoses that are connected to a traveling irrigation lateral and replace sprinkiers. Trailing tube irrigation should be considered as one alternative type of center pivot irrigation because of the potential benefits in energy saving and in water use efficiency. The hydraulics of trailing tubes were investigated in order to establish guidelines to serve as a basis for design. Factors considered include tube length, total flow rate, distribution of tube flow rate, and pressure distribution. The application pattern of a trailing tube was matched to the soil infiltration characteristics represented by a two-term infiltration model. Based upon this application pattern, the flow rate distribution, the total friction loss and the pressure distribution of a trailing tube were derived. Three numerical examples were presented to illustrate the application of the theoretical results in practice. (Moore-IVI)
W84-04096

HYDRO PLANT UPGRADED FOR HIGHER OUTPUT AND REMOTE OPERATION,
Burns and McDonnell, Kansas City, MO.
For primary bibliographic entry see Field 6B.
W84-04179

8D. Soil Mechanics

PREDICTING HYDRAULIC CONDUCTIVITY OF CLAY LINERS,
Texas Univ. at Austin. Dept. of Civil Engineering.
D. E. Daniel.
Journal of Geotechnical Engineering, Vol. 110, No. 2, p 285-300, February, 1984. 7 Fig, 5 Tab, 10 Ref.

Descriptors: *Linings, *Permeability coefficient, *Clay liners, Leakage, Permeability, Soil properties, Waste disposal.

The expanding use of compacted clay for lining waste disposal pits, solid-waste landfills, and water retention ponds has provided new field experience on the performance of clay liners. In a number of instances, the liners have leaked more than anticipated. Four projects are reviewed in which rates of leakage from ponds lined with clay significantly exceeded the rates that would have been predicted on the basis of lab permeability tests. The actual hydraulic conductivities of the clay liners were generally 10-1,000 times larger than the values obtained from lab tests on either undisturbed or recompacted samples of the liners. The major problem seems to be in obtaining a representative sample of soil for testing. Field permeability tests yielded results that compared well with field performance data. In all cases involving comparatively high rates of leakage, the liners were relatively thin (less than 0.6 m thick). With only one exception, all of the liners were subjected to some dessication. Until more is known the engineer is advised to use extreme caution in extrapolating results from lab permeability tests to the field. (Baker-IVI)
W84-03724

INDUS PARADOX,
National Inst. of Oceanography, Panaji (India).
R. R. Nair.
New Scientist, Vol. 101, No. 1397, p 41-42, 16 February, 1984. 2 Fig.

Descriptors: *Rivers, *Sedimentation, *Indus River, *India, *Gulf of Kutch, Tidal barriers, Flow, Tides, Sediments, Tidal powerplants.

During a study of the flow of sediment, especially particles of mica, in the Gulf of Kutch, in the Arabian Sea, abnormal variations in the distribution of sediment were noted in the adjacent continental shelf and the Gulf of Kutch which led to the concept of dynamic barriers. The Indus River discharges 200 cu km of water annually and carries to the head of the Arabian Sea some 450 million tonnes of suspended sediment each year. Some of the sediment settles immediately giving rise to the Indus delta. The current carries another part into the deeper area of the Arabian Sea as a dense sediment suspension through the Indus Canyon. Before the sediment-laden surface water actually reaches the Saurashtra coast it comes across an unusual diversion: a tidal barrier. Fine particles pass through the barrier, but coarser ones do not. Tidal currents carry the freshwater plume into and out of the Gulf of Kutch. The Gulf of Kutch is one of two regions on the west coast of India identified as suitable for a tidal power station. A drawback to any tidal power scheme is the accumulation of sediment behind its dams, a problem that becomes acute when the source of the sediment is at the head of the bay or gulf. The Gulf of Kutch receives sediments from the open ocean, ultimately coming from the Indus River. Thus the construction of dams in this area is less likely to cause siltation. For this reason, the Gulf of Kutch will be the first choice for tidal power. (Baker-IVI)
W84-03729

MAIN DIRECTIONS IN EFFICIENT DAM CONSTRUCTION IN THE NORTH,
L. I. Kudoyarov.
Hydrotechnical Construction, Vol. 17, No. 7, p 341-346, July, 1983. 5 Fig, 8 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 7, p 6-11, July, 1983.

Descriptors: *Dam construction, *Cold weather construction, Earth dams, Freezing, Soils, Hydroelectric plants, Diaphragms.

During the construction of the Vilyui hydrostation, which is being built under harsh climatic conditions, one of the most difficult processes was the construction of the facing. To keep the soils for the facing thawed during the winter, they were stocked in large piles during the summer and covered with a layer of salted soil 2-2.5 m thick. To reduce the depth of freezing the pile was covered with a layer of foam ice 0.5 m thick, which reduced the depth of freezing to 1 m. Electrical heating was used in the winter for heating the pile. In various places and under various climatic conditions, 18 hydrostations have been constructed with dams which have metal diaphragms. The possibility of deformation of the watertight element of the dam along with its shoulders without destruction is the main criterion of reliable operation of all earth dams. A dam with a metal diaphragm fully meets this condition. The use of asphalt diaphragms is also discussed. (Baker-IVI)
W84-03765

PROVISION OF RELIABILITY OF EARTH DAMS,
V. I. Vutsel'.
Hydrotechnical Construction, Vol. 17, No. 7, p 355-358, July, 1983. 1 Fig. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 7, p 16-17, July, 1983.

Descriptors: *Earth dams, *Safety, Dam construction, Regulations, Hydraulic equipment, Banks, Spillways, Drains, Dam failure.

The potentially dangerous centers of failure of earth dams are located mainly in the foundation and body of the dam. For high-quality performance of all types of main works on the construction of earth and earth-rock dams, the construction sites should be equipped with machines which make it possible to place the earth materials without their segregation, to compact them to the prescribed density, to treat the compacted soil layer, and other operations. Efforts should continue to be made to develop effective methods for field control of the quality of placing earth materials. Technological designs of earth dams for regions of high seismic activity need further consideration. Requirements imposed on reliability of dams should be increased. All operating high dams and those under construction should organize effective, automatic, monitoring systems. (Baker-IVI)
W84-03766

PERFORMANCE OF GRANULAR SOIL COVERS ON CANAL LININGS,
Bureau of Reclamation, Denver, CO.
C. W. Jones.

Journal of Irrigation and Drainage Engineering, Vol. 109, No. 1, p 1-12, March, 1983. 4 Fig, 2 Tab, 5 Ref.

Descriptors: *Granular soils, *Canal linings, Erosion control, Erosion, Membranes, Linings, Particle size, Soil properties, Performance evaluation.

It is necessary for canals to have surfaces that resist water erosion and displacement by other causes. The characteristics and observed stability of fine and coarse soil cover layers placed on 16 selected canal reaches to resist water erosion and to protect asphalt, plastic membrane, and compacted earth linings are reported. The canal test locations, canal design characteristics, physical properties of the covers, and observations on the performance of the covers over periods up to 25 years are given. Based on the experience of the Bureau of Reclamation with the performance of the test reaches, a range of grading for granular covers to control erosion on canal linings with similar conditions is proposed. Soils which have generally performed well in coarse cover layers on canals with tractive forces less than 0.1 lb/sq ft (5 N/sq m) have contained: (1) Maximum particle sizes between 3 and 6 in. (75 and 150 mm); (2) less than 50 percent passing a No. 4 (4.75-mm) sieve, and less than 10 percent passing a No. 200 (75-microm) sieve. To control sloughing of cover soils, consideration should be given to the grading of fine soil beneath coarse granular layers, and where economically justified, controlling moisture and density. (Murphy-IVI)
W84-04034

CENTRIFUGE SIMULATIONS OF STABLE TAILINGS DAM,
Sandia National Labs., Albuquerque, NM.
H. J. Sutherland, and R. P. Rechard.
Journal of Geotechnical Engineering, Vol. 110, No. 3, p 390-402, March, 1984. 12 Fig, 2 Tab, 17 Ref. Bureau of Mines contract J0295038.

Descriptors: *Model studies, *Centrifuge simulations, *Tailings dams, Simulation, Phreatic surface, Dam safety, Scale models, Earth dams.

The development of the phreatic surface in a stable tailings dam is investigated by using centrifuge simulation techniques and analytical techniques. The centrifuge simulations, conducted on an 8 m radius machine, use a 'modeling-of-models' approach to determine the effects of scaling and model construction on the development of the phreatic surface. The analytical techniques are used to predict the location of the steady-state phreatic surface in the equivalent full-scale prototype dam and to determine its stability in terms of the conventional factor-of-safety. While the analysis indicates that there should by no scaling effect on the steady-state phreatic surface, the simulations show a rise in the phreatic surface with increased scaling. Numerical predications of the steady-state phreatic surface compare well with data taken below 100 g scaling. (Author's abstract)
W84-04088

8E. Rock Mechanics and Geology

EFFECT OF CHEMICAL INJECTION STABILIZATION ON GYPSUM STABILITY IN THE FOUNDATION OF HYDRAULIC STRUCTURES,
N. G. Maksimovich, and V. I. Sergeev.
Hydrotechnical Construction, Vol. 17, No. 7, p 380-384, July, 1983. 5 Fig, 7 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 7, p 30-32, July, 1983.

Descriptors: *Gypsum, *Dam construction, *Foundations, Stability, Seepage, Dam failure, Foundation failure, Karst, Seepage.

Hydrotechnical construction in gypsum regions can create conditions for the development of a karst and threaten existing structures. The rate of dissolution of gypsum, if the seepage flow is able to dissolve it, is determined by the rate of the flow. One method to reduce the seepage flow rate is to create a grout curtain. To increase the density of grout curtains made in finely jointed gypsiferous rocks, chemical gel-forming solutions (oxaloaluminosilicate formulation) having a penetrativity close to water have recently been put into practice. Solutions containing components of the oxaloaluminosilicate formulation on interacting with gypsum not only do not dissolve it, but form on its surface compounds which are quite difficult to dissolve (calcium oxalate, and calcium hydrosilicates) which can be regarded as films protecting gypsum from dissolution. This procedure is recommended for prospective additives to clay, clay-cement, and cement grouts when stabilizing gypsiferous rocks. (Baker-IVI)
W84-03768

8F. Concrete

PREVENTING CAVITATION DAMAGE TO HYDRAULIC STRUCTURES; PART THREE,
W. S. Hamilton.
International Water Power and Dam Construction, Vol. 36, No. 1, p 42-45, January, 1984. 8 Fig, 26 Ref.

Descriptors: *Cavitation, *Air entrainment, *Spillways, Hydraulic structures, Fluid mechanics, Jets.

A simplified approach is offered to the analysis of the cavitation phenomenon with a description of the physical characteristics of cavitation and some examples of spillways where problems have been experienced. Specific attention is given to the air entrainment mechanism, entrainment from a cavity below a nappe, length of cavity, and jet creation and air supply. Specific sites discussed include Palisades dam outlet sluices, Yellowtail dam spillways tunnel, and the Ust-Ilim spillway. In areas where a concrete surface has been rather badly damaged by cavitation, a supply of entrained air may not completely stop further erosion of the damaged area but it will at least retard the erosion process. In one given example air appears to be protecting concrete in which there were already holes 30 cm or more deep. (Baker-IVI)
W84-03727

ANISOTROPY OF ELASTIC PROPERTIES OF CONCRETE WITH TABULAR GRAVEL,
I. E. Pukhov, V. V. Bobrova, and G. N. Kuleshov.
Hydrotechnical Construction, Vol. 17, No. 2, p 366-370, July, 1983. 1 Fig, 4 Tab, 4 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 7, p 22-24, July, 1983.

Descriptors: *Dam construction, *Concrete technology, *Anisotropy, *Gravel, Construction, Concrete construction, Andizhan reservoir.

Experimental investigations were carried out at the construction site of the Andizhan reservoir to establish the presence of anisotropy of the elastic properties of mass concrete. Tests on the concrete on laboratory specimens and cores drilled from experimental blocks showed that at an early age the elastic and strength properties of the concrete with coarse tabular aggregate are anisotropic and at a late age are isotropic. This can be explained by the fact that the main source of anisotropy of the properties of concrete - air-filled voids under the coarse aggregate - gradually decrease with age of the concrete and almost completely disappear in old concrete. Such a conclusion is based on the generally known fact indicating that as the concrete ages the smallest pores and cavities in it, decreasing in volume, are filled with cement hydration products. In this case the concrete becomes more dense and homogeneous. (Baker-IVI)
W84-03767

USE OF CONCRETE FOR RETAINING WATER,
Birmingham Univ. (England). Dept. of Civil Engineering.
B. P. Hughes.
International Water Power and Dam Construction, Vol. 36, No. 3, p 18-20, March, 1984. 2 Fig, 9 Ref.

Descriptors: *Cement, *Concrete, Hydraulic structures, Dam construction, Permeability, Joints, Cracks, Temperature effects, Shrinkage.

Good quality well compacted concrete is an ideal material for retaining water because of its impermeability, availabilty and durability. The use of both mass concrete and reinforced concrete for retaining water is considered and the need for good design and practice with regard to thermal and shrinkage effects is emphasized. All concretes contract because of early thermal movement and shrinkage. Loss of watertightness because of cracking can therefore occur and must be controlled through one of several ways: use of very low cement contents and limit initial concrete temperature so that total contraction strain is insufficient to crack; limit severely cement content and initial concrete temperature and reduce external restraint to concrete to prevent cracking; limit cement contents and design reinforcement to control cracking to within design widths for estimated maximum initial concrete temperature; and design movement joints to reduce restraints and provide freedom of movement while retaining very nominal reinforcement. (Baker-IVI)
W84-04079

8G. Materials

COOLING WATER FACILITIES AT A NUCLEAR STATION,
Arizona Public Service Co., Phoenix.
For primary bibliographic entry see Field 8A.
W84-03712

STUDIES ON VINYL CHLORIDE MIGRATING INTO DRINKING WATER FROM POLYVINYL CHLORIDE PIPE AND REACTION BETWEEN VINYL CHLORIDE AND CHLORINE,
National Inst. of Hygienic Sciences, Tokyo (Japan).
For primary bibliographic entry see Field 5B.
W84-03733

9. MANPOWER, GRANTS AND FACILITIES

9A. Education (Extramural)

DESIGN OF A WATER RESOURCES TRAINING PROGRAM FOR OPERATION, MAINTENANCE AND MANAGEMENT,
District of Columbia Univ., Washington. Water Resources Research Center.
M. H. Watt, T. J. Karikari, and A. Bunyan.
Water Resources Research Center Report No. 56, October, 1983. 207 p, 4 Fig, 13 Tab, 140 Ref, 10 Append.

Descriptors: *Training, *Water distribution, *Sewer services, *Job analysis, *Wastewater treatment, Plant operation, Maintenance, Management, Curriculum development, Need-to-know, Local organization, Washington, D.C., On-the-job training, Apprenticeship, Certification, *District of Columbia.

A long-term training program was designed for operating personnel in three bureaus (Water Services, Sewer Services, and Wastewater Treatment) within the Water Resources Management Administration (WRMA), a division of the D.C. Department of Environmental Services (DES). The project consisted of: an analysis of the agency's structure; a survey of the employees background; a survey of job and task requirements; an assessment of documentation of training needs based on workers and supervisors views; and analysis of job and performance functions; and the implementation of a pilot program aimed at providing information about the training level of workers, trainees and supervisors acceptance, selection of training methods, training facilities, and other factors relating to a long-term training program. Recommendations on a comprehensive long-term curriculum leading

to certification are provided. The report also gives guidelines for apprenticeship, certification and a comprehensive list of courses related to the training of water resources operators and technicians.
W84-03662

9B. Education (In-House)

DESIGN OF A WATER RESOURCES TRAINING PROGRAM FOR OPERATION, MAINTENANCE AND MANAGEMENT,
District of Columbia Univ., Washington. Water Resources Research Center.
For primary bibliographic entry see Field 9A.
W84-03662

10. SCIENTIFIC AND TECHNICAL INFORMATION

10C. Secondary Publication And Distribution

USERS GUIDE FOR THE WATER RESOURCES DIVISION BIBLIOGRAPHIC RETRIEVAL AND REPORT GENERATION SYSTEM,
Geological Survey, Reston, VA. Water Resources Div.
N. Tamberg.
USGS Open-File Report 83-691, 1983. 114 p, 14 Fig.

Descriptors: *Documentation, *Information retrieval, Computer programs, Data storage and retrieval, Bibliographies, *Hydrologic information.

The WRDBIB Retrieval and Report-generation system has been developed by applying Multitrieve (CSD 1980, Reston) software to bibliographic data files. The WRDBIB data base includes some 9,000 records containing bibliographic citations and descriptors of WRD reports released for publication during 1968-1982. The data base is resident in the Reston Multics computer and may be accessed by registered Multics users in the field. The WRDBIB Users Guide provides detailed procedures on how to run retrieval programs using WRDBIB library files, and how to prepare custom bibliographic reports and author indexes. Users may search the WRDBIB data base on the following variable fields as described in the Data Dictionary: Authors, organizational source, title, citation, publication year, descriptors, and the WRSIC (accession) number. The Users Guide provides ample examples of program runs illustrating various retrieval and report generation aspects. Appendices include Multics access and file manipulation procedures; a 'Glossary of Selected Terms'; and a complete 'Retrieval Session' with step-by-step outlines. (USGS)
W84-03557

WATER-RESOURCES STUDIES IN UTAH BY THE U.S. GEOLOGICAL SURVEY, JULY 1, 1982, TO JUNE 30, 1983.
Geological Survey, Salt Lake City, UT. Water Resources Div.
USGS Open-File Report 83-531, July, 1983. 49 p, 3 Fig. Compiled by Hamblin, L. S.

Descriptors: Water resources studies, *Projects planning, *Utah, *Cooperative studies.

Twenty-three studies of water resources in Utah were conducted by the U.S. Geological Survey during the period July 1, 1982, through June 30, 1983. Seven of these studies were completed on June 30, 1982, or will be completed on September 30, 1983. Eighteen of these studies were in cooperation with Federal, State, county, or local agencies. Three additional studies are proposed to begin on July 1 or October 1, 1983. The 26 current and proposed projects included 7 involved mainly with collection of data, 6 concerned with the hydrology of Utah's energy-resource areas, 3 concerned with surfacewater flow, 4 on ground water in unconsolidated sediments in the basins of western Utah, and 4 concerned with ground water in consolidated rock, mostly in southeastern Utah. (USGS)
W84-03559

GERAGHTY AND MILLER'S GROUNDWATER BIBLIOGRAPHY, THIRD EDITION,
Geraghty and Miller, Inc., Syosset, NY.
F. van der Leeden.
Water Information Center, Syosset, NY, 1983. 330 p.

Descriptors: *Groundwater, *Bibliographies, Groundwater management, Groundwater protection, Groundwater contamination, Energy development, Exploration, Model studies, Legal aspects, Water quality, Groundwater flow.

This third edition of the bibliography contains over 4,500 selected references on groundwater, including both 'classic' works and significant new publications in the rapidly growing groundwater field including management, protection, contamination, exploration, energy development, modelling, and the law. The bibliography is divided into a General Section containing a listing of general bibliographies, periodicals and books followed by a Subject Section listing 29 topics. Chapters include: Exploration Techniques/Mapping and Data Collection; Geophysical Investigations; Spring/Seeps/Geothermal Resources/Heat Pump; Theory of Groundwater Flow; Tracers and Groundwater Dating; Natural Water Quality; Groundwater Contamination; Radionuclides in Groundwater/Nuclear Waste Disposal; Subsurface Disposal/Deep Well Injection; Salt-Water Intrusion; Well Design and Construction/Drilling Methods; Artificial Recharge/Wastewater Reclamation; Groundwater Models; Land Subsidence/Sinkholes/Uplift; Groundwater Law/Regulations/Legal Issues; Groundwater Management and Conservation; Education Training; and Water Witching. There are no author and subject indexes; convenient subtopics are arranged under each chapter for subjects and then listed by major author's surnames.
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